Table of Contents

U.S. DEPARTMENT OF COMMERCE
National Institute of Standards and Technology

Public Meeting to Present Progress and Preliminary Findings of the NIST Federal Building and Fire Safety Investigation of the World Trade Center Disaster

Morning Session, February 12, 2004

Dr. Hill: Good morning. My name is Jim Hill. I'm currently the Acting Director of the Building and Fire Research Laboratory at the National Institute of Standards and Technology. Welcome to this public meeting on the federal building and fire safety investigation of the World Trade Center disaster.

The first thing I'd like to do is to inform you on the emergency exit routes out of this particular room. This is a diagram, the layout of the third floor of the hotel. We're in this room right here, this is the podium where I stand, and in case of an emergency, you can go out the side doors here. You'll have to walk through a kitchen door, but there's a stairway where you can go out to the outside. In a similar way, if you go out the two side doors on the opposite side of the room and simply walk down the hall, there's a stairway here, there's also a stairway here that will lead out of the building.

The purpose of today's meeting is to brief you, the public, on the status of the investigation that we're conducting and to gather public input in three areas: specific technical aspects of our investigation; suggestions for things we should consider within the time and scope of our current eight projects: and areas we should consider for specific improvements to building practices, standards and codes.

We have a very busy, tight schedule for the day, and we're going to do the following: First, our lead investigator will give you a detailed report on the status of our investigation. As you will hear, it's well under way and scheduled to be completed by early next fall. Twenty-four people had preregistered to formally address the NIST team today. We hope to complete about half of these presentations before lunch. We'll take a lunch break at 12:15. And the other half will be completed after lunch, starting at 1:45.

There is an opportunity for additional people to sign up to speak this afternoon. Registration forms are outside at the registration desk. We'll accept those requests up until noon, and then we'll schedule the additional speakers this afternoon on a first-come, first-served basis. Finally, there's going to be an opportunity for anyone from the public to ask questions of our lead investigator and the other NIST team members who are here at two different sessions. One will run from 1:15-1:45, right after lunch. The other one will run from 3:30 to 4, later in the afternoon. If the press wants to present any questions to us offline, we're happy to accommodate you. Michael Newman at the back of the room is from our Public and Business Affairs office and he'll be happy to arrange that with you. I'd also like to introduce at this time, Mat Heyman, at the front of the room. Mat is the NIST Chief of Staff. He's here today to help out in any needs that individuals may have.

We hope to complete the meeting and adjourn by 5 p.m. A transcript of today's meeting will be posted on the NIST WTC Investigation web site. It'll be up here on the screen in just a moment. If you want to provide us additional information after today is over, you can also contact us in a number of different ways that will also be on the screen shortly.

Many of you are aware that this investigation is being conducted under the auspices of the National Construction Safety Team Act. It was an act passed by Congress and signed into law by the President in October of 2002. This law gave us many authorities that are similar to those of the National Transportation Safety Board. However, there is one major distinction. This investigation is conducted inside of NIST. There is no Board like there is with NTSB. In fact, the NIST Director serves in that capacity.

The law did authorize an advisory committee whose purpose is to advise the NIST Director on our procedures, activities, investigations, and recommendations. We've been very fortunate. We have a current advisory committee that consists of ten superbly qualified individuals who've been in place for a year. They've met with us collectively three different times during the past year, and they've just finished their first report to Congress that was delivered earlier this week. Copies of that report are on the table outside of the room if you're interested.

Some of the members of the advisory committee are here today. First, I'd like to introduce Paul Fitzgerald. Paul, would you stand? He's the Chairman of the Committee. He's had a distinguished technical and executive career with FM Global, one of the world's largest commercial and industrial property insurance organizations. Glenn Corbett. Glenn is professor of public management and fire science at the John Jay College of Criminal Justice here in New York City. He's had extensive experience in fire protection and fire science. He's going to address the group later this morning and give us his comments as an individual professional, not as a member of the NCST Advisory Committee. We also have David Collins with us. David is a president of The Preview Group in Cincinnati, Ohio, and extremely knowledgeable in the field of building codes. There are no other members of the Advisory Committee with us today.

So without further ado, I would like to go to the first segment of our program and introduce to you, Dr. Shyam Sunder. Shyam is Chief of the NIST Materials and Construction Systems Division. More importantly, he's the lead investigator for this investigation, and he's going to give you a status report on our investigation.

I will ask everyone in the audience, if they would, to please turn off their cell phones during the proceedings. Thank you.

Dr. Sunder: Good morning. Jim has already introduced me as the lead investigator for the federal building and fire safety investigation of the World Trade Center disaster, and I will take this time this morning to explain to you our overall goals, our objectives, and where we are in terms of status and progress on the investigation.

Quite – it was about 19 months ago, June of 2002, that we held a public meeting here in New York City to gather input from public and technical organizations on our plans to start this investigation. The plans were then modified to incorporate those comments, and we launched the investigation at the end of August of 2002. So we've been into this investigation now for about 17 months. And as Jim said, we expect to have a report drafted in early fall of next year – of this year. Our goals and objectives are really to investigate the technical aspects of the World Trade Center building collapses and the loss of life, with the ultimate objective of trying to help improve – make improvements in safety for the future, and specific changes to codes and standards where they may be warranted.

Now, we know close to 2,749 people, including more than 400 first responders, lost their lives on that day due to the terrorist attacks. We also acknowledge the heroic efforts of the first responders in search and rescue who gave freely of their lives.

The investigation itself is unprecedented in scope and complexity. It is the most complex analysis of a building failure ever conducted. NIST investigations are independent, objective, and impartial, and that's what we intend to do. Our recommendations that will result from this investigation, we expect, will be given serious consideration by the private sector organizations that develop national standards and model codes. Those model codes provide the minimum requirements for public welfare. And those model codes then become regulation when they're adopted by the numerous state and local jurisdictions in this country.

The investigation is organized around eight major projects. It's one investigation, there's one investigation leader, there are eight people who are assisting, or ten people who are actually assisting me in this investigation as part of a team, and organized around the physical aspects of what happened on 9/11, the people aspects of what happened on 9/11, and the first responder aspects of what happened on 9/11. We started nearly a year after the event, and hopefully the new Act that's been passed by Congress will prevent us from starting that late in the future. Hopefully it'll happen within the first 48 hours as the Congress intended for us to start.

But prior to our investigation, there was a study that was done by the – funded by the Federal Emergency Management Agency and carried out by the American Society of Civil Engineers. And there were a number of findings and recommendations made in that study, which have informed what we do. However, our study goes beyond the physical aspects to also look at the people aspects and the practice aspects.

We've made good solid progress in all of those eight projects. The investigation itself was given a special appropriation by Congress of $16 million. And about $5.5 million of that is awarded in contracts. We are drawing on complementary talent from NIST, outside experts, and the contractors. We want the best people in the country to help us with doing this investigation. And that's what we are help – the contractors and experts are helping us do. Ultimately it's NIST, not the contractors and experts, who is responsible for determining what our findings are, what our conclusions are, and what recommendations we will make. And, of course, we will have input from the advisory committee in terms of formulating those findings and recommendations.

We've issued two – we've been very open with the public in terms of providing briefings. We issued two written updates, and I encourage you to take a look at them on our web site. It's just simply wtc.nist.gov. We've issued two technical – one technical progress report, and we expect to release another one in early spring this year. And the draft investigation report is planned for completion in early fall.

I want to start first by talking about data collection because this is a very, very important aspect of what we're trying to do. We've collected a very large amount of data and information from a whole host of organizations: The building owners, the designers, the City of New York, both the fire department, the police department, and numerous other organizations that support this, including suppliers of materials, such as fireproofing.

We have a few requests for materials that are lost, currently pending, or not yet located. We are making every effort to recreate that information, since much of it was lost when the buildings collapsed, especially those that deal with the buildings themselves. We, at this point, believe that we have received all of the essential information for us to do a credible investigation. And we have said that for the past three months, while we continue to work the problem of the few

pieces of information that we still seek. And in doing so, we've received considerable cooperation from a whole host of organizations, including survivors and victim's families.

I'm going to touch on a number of aspects of our investigation which I think it's worth for the public to know at this point in time. First of all the issue with regard to the safety of the towers in an aircraft collision. Buildings are not designed to withstand the impacts of fuel laden commercial airliners. However, in the case of the World Trade Center, it was a consideration. The structural safety of the towers in an aircraft collision was considered in the original design. We have some documents from 1964 that suggest that.

The impact scenario that was considered is a Boeing 707 traveling at 600 miles an hour. There's another document a month later that considers an aircraft impact at the 80th floor of one of the towers. When you put those two together, the events of September 11th look strikingly similar.

The analysis that was reported from that time indicated that such collision would result in only local damage which could not cause collapse or substantial damage to the buildings. We now know that the buildings withstood the initial impact of the aircraft. The loss of life would have been far greater had the buildings collapsed upon impact. The large size of the buildings, the 208 x 208 feet floor plan area, and the dense exterior grid of columns, enabled the buildings to withstand the initial impact of the airplanes. But when you go beyond the initial impact to look at fire safety and life safety, we find that there are some contradictory views.

There are two views on whether or not the effect of jet fuel and the subsequent – and the aircraft contents with regard to fire safety was considered or not. One view suggested that the fuel would dump into the building and there would be a horrendous fire. The second view suggested that possibly the fuel load and the fire damage may not have been considered. These are the opinions of people who should know what was done at that time.

With regard to life safety, there are two views, again, on what would be the effect on occupant life safety. One view, which considered the fires, suggested that – one view which did not consider the fire suggested that the aircraft impact would not have endangered the lives and safety of occupants not in the immediate area of impact. Another view, which considered the fires, which took that into account, recognized that a lot of people would be killed, even though the building structure would still stand.

We are still hopeful that we'll have further information available from wherever it resides, from the public, from people who know, to help us to better understand these different perspectives. And if we can get documents, that would be even better.

A key element of what we're trying to do is to assess the most probable structural collapse sequence of the three buildings that are under investigation. It's the WTC towers and WTC 7 – that's the 47-story building that collapsed later that day, around 5:20 in the afternoon. Each of the towers failed in a different fashion or collapsed in a different fashion. And what we are trying to do is to seek – we're trying – or we're seeking to determine the most probable collapse sequence for each of those buildings, and we intend to do that.

These will be based on photographic evidence that we have, I'll talk about that, rigorous computer modeling, laboratory simulations, and well-established statistics and probability-based methods for failure analysis. And we have an excellent framework and methodology to actually pursue this topic.

At this point, I want to talk about some of the innovations that were part of the tower design. We've all heard of the fact this was a frame-tube system, unlike a traditional frame structure. The towers' structural system was an innovation at its time. And just to give you an example of that innovation, 14 different grades of steel were used in the design of these building. Even today, only two or three grades of steel are used in a typical building.

The composite floor truss system, which used long span, open web bar joists and spray-applied fireproofing, was also an innovation in its day.

The design of the towers for wind loads, that was the governing design loads in this building, and the control of wind-induced motions were also innovative. There have been three sets of wind tunnel tests done on these buildings. One was done in the 1960s when the buildings were designed. Two sets of tests were done in 2002 as part of an insurance litigation for the two different parties to the litigation. We have found that there are large differences in the test results of all of these three tests. The tests that were done in 2002 were done by companies that do these kind of tests for engineering practice. And when I talk about large differences, we're talking about tens of percent, not less than 10%. We believe as a result of this that we're going to be considering recommendations for improvements of standards to insure repeatability and transparency of wind tunnel tests and methods used to estimate design wind loads from test results for use in practice.

And one of the last – one of the other examples of innovation is the elevator system design. The use of the combination of express elevators to sky lobbies and then local elevators to specific floors within a – between sky lobbies, was an innovation at its time. What that allowed – or made possible – was that it maximized tenant space while reducing requirements for elevator shafts in the core of the space that would be used by elevator shafts. So the same set of elevator shafts worked for elevators in the bottom third of the building, the next third of the building, and the middle third of the building.

Let me now move to the analysis of structural steel. We believe that the collection of steel from the towers that we have is adequate for purposes of our investigation. We have, at this point in time, 236 major pieces of steel, World Trade Center steel, in our possession. That steel was very carefully selected from the salvage yards by technical experts of the Structural Engineers Association of New York working with NIST staff and the ASCE team that did the earlier study. And as they went through the large amount of steel, they picked the steel that was emphasized in the regions of impact and fire damage in the building.

We have all 14 grades of steel that were used on the exterior panels. We have the two specified grades of steel that represented 99% of the core columns in the buildings, and we have both the specified grades of steel for the open web bar joists elements that comprised the composite floor truss system. And this little sketch to your right with different colors, shows you, at least schematically, how those different grades of steels were used in the buildings, the red being the strongest grade of steel of about 100,000 – steel capable of carrying about 100,000 pounds per square inch. While the bluer ones are the more routine kinds of steel that carry between 36,000 to 45,000 pounds per square inch of load.

We've done a bunch of room temperature tests, a very large number of room temperature tests on those steels. These are small specimens of steel, not entire beams and columns, and that's the standard test using ASTM specifications, and our results showed that the measured room temperature strength of the steel met the specifications, and in many cases, exceeded those by

between 5,000 and 10,000 pounds per square inch. We're still working to evaluate the design of the steel buildings components and system and their performance under impact and fire conditions, up until the time of collapse initiation. That work is not complete. We're still talking about the material properties of steel.

Over the life of the buildings, the fireproofing and fire rating of the floor system has been an issue that has been studied. We reported last May, there appears to have been no technical basis for selection of the fireproofing materials for the World Trade Center floor system. We also reported that the specified fireproofing thickness to achieve the two-hour rating was something for which we could not find a technical basis. Now project-specific fire endurance testing was not and is not normal practice, but may be conducted when circumstances warrant it, for example, in a new or innovative application. But what we have to keep in mind, that in 1966, the architect of record for the towers, and in 1975, the structural engineer for record the towers, stated that the fire rating of the floor system could not be determined without testing. We have not found any evidence indicating that a test based on ASTM E119 had been conducted to determine the fire rating of the floor system. The Port Authority has informed us in writing that there are no test reports in their files at this point in time.

We have awarded a contract to the Underwriters Laboratories to determine the fire rating of the typical World Trade Center floor system under both as-built and as-specified conditions, and these are different. What was specified was ½-inch of fireproofing. What was generally built was ¾ of an inch on average, and in some cases they were being upgraded to an inch and a half. We expect the tests to be conducted in late spring of this year.

As we have gone through this work, we have found that the origin of the current fire endurance rating test method is nearly a century old. Hourly ratings are relative and apply to sub-assemblies, small components, tested in a standard fire. Those may not be adequate for major fires and the buildings as a complete system. We are considering the need for recommendations to improve methods to determine the fire endurance rating of the building system in major fires. And as time goes on, we'll better formulate those recommendations.

We have conducted a large number of experiments as we seek to model how the fires started, evolved, and spread throughout the hour and a half that these two buildings were in flames and the much longer time that World Trade Center 7 was on fire. We've completed four different sets of tests. One set of tests dealt with, which is on your top left of the screen, dealt with the prediction of steel temperatures through the fireproofing. And we've done it both with fireproofing and without fireproofing, so that we have confidence in our ability to predict the temperatures on the steel. We've also done tests on the ceiling tile systems and what would the impact have caused in terms of damaging or dislodging the ceiling tile system.

A third set of tests that we completed in late summer, last year, was what we called single workstation burns. These are the office modules typical of what was in the World Trade Center towers. And these single workstation burns become input to our fire dynamics models. And later in the fall, we completed a set of what we call multiple workstation burns, which would be used to validate the predictions of our models. And we – I'm glad to report, and this work was led by Dick Gann who is sitting in our audience, I'm glad to report that our model predictions are in good agreement with the experiments.

So, what that's helping us to do is predict the fires, and in order to predict the fires, we need to have a very, very accurate model of the buildings. We need to have an accurate model of the extent of the damage caused to the buildings by the planes and a very good model of the actual

interior layout of these buildings. We've had good cooperation to get that interior information, especially for Tower One. In Tower Two, there are – we would like to get some more information on the interior of those buildings, and we are working with the owners, the tenants, who have that information, and we hope they will be forthcoming with regard to that information. But it's still valuable and so important for us to get it.

Here is a simulation. This is our model. And you see what a high fidelity model it is to see how we're modeling. You're zooming in from outside the building, through the damage caused by the airplane, and seeing what is inside the building. This is going to run for a few minutes, here, and I'd be happy to run this during other times this day if you'd like to see it for a longer time. But once we can model the interior of the buildings, we – then know what the combustibles within the buildings were, the carpets, the furniture, the paper, the books, the cabinets, the partitions, and so forth.

Now, several of you have heard about or thought about the fact that the jet fuel would have burned, caused the building to burn, and probably think the jet fuel played the sole role in the fires. The jet fuel acted much like a matchstick. It was something that spread throughout the building in those affected floors and caused ignition of the fires. But the jet fuel itself burnt in a matter of minutes, within less than ten minutes. So what burned over the next hour, or hour and a half, was really the contents of the buildings, the everyday contents of the buildings. And the model that I'm going to show you at the bottom, shows you how the fire was burning in the buildings. The red blotches are the hot temperatures of the gas, and the green is intermediate, and blue is the cold regions. And as you go over time, you will see that the hot regions evolved. Typically, a region remains hot for about 15 to 20 minutes. By that time, the contents in that region are consumed, and the fire moves to the next region where the contents have not been burned, and if there's oxygen, it will go there. If there's no oxygen, it won't go there. So, how we captured the availability of oxygen in predicting the fires is also very important.

Now, in order to help us with this modeling, we have, and to validate the results of this modeling, to make sure it's consistent with what we observed, we have collected a very large visual database. That visual database, at this point, consists of little over 6,000 photographs, taken by more than 85 photographers, and about 150 hours of videotape, representing more than 20 sources. And let me just say there's both a whole host of professional and amateur people, as well as major media outlets that have contributed to this collection. And for those of you in the major media, we also have a lot of outtakes, which typically, is hard to get. So we've had excellent cooperation from numerous organizations to help us do this.

What we're doing with that information is developing a timeline of the fire, the smoke, and the condition of the windows at specific times for each tower. And we intend to do that also for WTC 7. Those are the ways in which we can validate what we're predicting with our models. And I will show you here a simulation that takes all of those photographs and reduces it to a representation like this of the building. The red is where you can see fires outside the window. The green is where the fires are within the window. The black is where you have windows that are broken. And bottom of the page, you see times. We're giving you this on an every two-minute basis. And, so, this helps us with the fire modeling. We're also getting information on the aircraft impact and the extent of the building damage from this visual information, very valuable information.

I offer this up, not so much for you to grasp everything that's on this chart, but to suggest to you that the kind of integration that we're doing in the modeling has never, ever been done before. We're integrating fire science and structural engineering. This is a leading edge technical

development never done before in the building industry, and is on par with work on space travel and blast effects. Currently, architects specify fireproofing in buildings. What we are developing is a technical foundation and tools that will allow engineers to design structures for fire safety as they do today for earthquakes and wind.

Major developments in earthquake engineering were stimulated by major California earthquakes in 1971, 1989, and 1994. Likewise, major developments in wind engineering were stimulated by the experience in the 1940s with the Tacoma Narrows Bridge, in the 1970s with Boston's John Hancock Tower and New York Citicorp Center, and Hurricane Andrew in 1992. In much the same way, the terrorist attacks of 9/11 are helping us move the technology of fire, and structural safety of buildings under fire, forward.

We are making every effort to draw a distinction between the unique circumstances of the events that occurred as a result of the terrorist attacks and the intrinsic safety issues that cut across a range of threats, including major fires, earthquakes, and hurricanes. This kind of integration, as I said before, has never been done. And we're going to be doing that to predict the probable collapse sequence. This work is under way, and over the next 3 to 4 to 5 months we'll make a tremendous amount of progress in better understanding where we are.

As I said before, life safety and emergency response is a very important aspect of what we're doing. A key element of that work is first person data on occupant behavior, evacuation, and emergency response. Buildings are designed for fire protection and evacuation under normal fire conditions, not for conditions found in major emergencies. There is a critical lack of information on which to base such evacuation and emergency response practice, standards, and codes. The first person interviews of occupants, current and retired first responders, and a number of them retired soon after 9/11, and family members in contact with the victims in the buildings, are providing valuable information regarding major emergencies in tall buildings.

We are focused on 3 or 4 specific things: Firefighting, how much time it takes for an individual to get up there to the 60th floor. Many of you may not know, it takes about a minute per floor to get up to a particular floor, especially if the elevators aren't working. So if you have a fire, it's going to take 60 minutes to get up to the 60th floor. There's an issue with regard to when this individual goes up, or these individuals go up, whether they can fight the fires, or is it too late? And whether or not the first responders can help with evacuation, or if that's not possible.

It raises also the issue of the use of elevators for emergencies. This is something that is done in the United Kingdom. It's not done in this country, and we have been working with the elevator industry, actually, since the late '70s on that. We're revamping, reenergizing that interest, and Dick Bukowski here is working with the elevator industry to help make that possible.

Evacuation in tall buildings. Our current strategy is what's called "defend in place" or phased evacuation. That's – typically the scenario is one or two affected floors, and take the people from the affected floor off to an adjacent floor in a holding pattern and do what emergency response you need to do, and then bring the people back. That means the capacity of the stairwells, the staircase – the stairwells and the stairs, and the number of stairs, the location of the stairs, is all based on the strategy of "defend in place". It's not based on full evacuation of a building.

Now, many of you probably have experienced, in some buildings, that on occasion, you have had to evacuate an entire building. The question that raises for designers is, what should be the design capacity of the egress for those buildings? What should be the amount of time that you

should allow for the buildings to be evacuated in an emergency. Those kinds of questions, things that need to be thought through further. And we're trying to get information on those kinds of issues through our first person data collection efforts. And, of course, we are talking about building design features and command control and communication in major events, which many of you have read about in the literature and in the newspaper.

We've made a lot of good progress in the first person data collection effort. We have spoken, at this point, to over 1,000 survivors of 9/11, 800 of them have gone through a telephone interview process, 200 through an extensive face-to-face interview process, of which, 130 of them represent occupants and the remainder represent first responders from the fire department, the Port Authority, and the police department. And we're still in the process of working more of these over the coming weeks. We have guaranteed that the privacy and confidentiality of the individual respondents will be protected to the maximum extent permitted by law.

Now, in doing this first person data collection, and actually studying more broadly about emergency response and evacuation, we're collecting data from multiple sources. And this just gives you a list of that. I think the only thing that I want to sort of point out, is – two things here. We have received over 1,000 hours of recordings from the Port Authority of New York and New Jersey, and New York Police Department, of their communication tapes. We have looked at them fairly carefully and will begin to write up our findings in the future. We have already started talking about the preliminary findings from those reviews.

And we've earlier – we've also begun our review of the 911 tapes and logs, as well as the transcripts of 500 interviews with fire department employees that was conducted by the New York City, soon after 9/11. And that work will proceed, and we hope to have that completed by the end of March.

The result of our work on occupant behavior, evacuation, and emergency response will be a detailed chronology of the events. We'll analyze the emergency communications data to better define the events of September 11, and to document the performance of the emergency communication systems. And we'll then be using computer models of egress to better understand the evacuation experience on 9/11.

Well, let me go through some of the preliminary findings from our first person data collection effort. And I've broadly – have categorized them under three areas: Evacuation, emergency response, and building damage. We find, on a preliminary basis, that most people had participated in evacuation training and knew where the closest stairwell was located. Most respondents indicated that they had not ever used the stairwell system. Many people found stairwell transfer floors confusing on 9/11. Now some of this was reported previously, but this is now a systematic analysis of people's inputs.

The ingress/egress was a tremendous physical challenge for both first responders and many occupants. Inadequate footwear presented a mobility challenge, as discarded shoes often littered the stairwells, leaving many people shoeless. So this is to tell you that there are big and important, important things, some things that might seem trivial that can become very important in emergency situations.

With regard to emergency response, all of the radio communications evaluated so far experienced surge load conditions after the attack. And as a result, roughly a third to a half of the communications were not complete, and the traffic volume made it difficult to handle flow

and delivery of information. Multiple concurrent transmissions on the same frequency, which is called doubling, made it more difficult.

Second, the first responders, including key incident commanders, did not have adequate information; voice, video, or data on, and an overall perspective of the conditions in the buildings, and what was happening elsewhere at the World Trade Center site. Interagency information sharing was inadequate. One might say that the information on – that people had on TV screens at home, may have been, sometimes, more comprehensive.

Building damage. This goes back specifically to World Trade Center 7, especially on the south face, because we did not yet have a comprehensive understanding of what ignited the fires in that building and caused it later to collapse. And we have not had much success with photographs of the south face because it was a face A: Where not too many photographers were present and B: There was a thick smoke in front of the buildings that made it very hard for any photographs to penetrate the smoke.

However, there have been at least multiple people that we have talked to from the fire department, first responder community, that have observed what happened on the south face of WTC 7. And they report there was a large gouge on the south face of World Trade Center 7 extending from the sub cellar to the 10th floor, approximately, and covered roughly a third of the face, wide, and about 15% to 20% of the building deep. So that was a major, physical damage to the building. We are now understanding what the implications – trying to understand what the implication of that was on weakening the structure and the fire ignition and spread in that building.

So as you can see, we've received some very valuable information from the first person data collection. And there'll be a lot more coming. This – we're just beginning to analyze the information.

As far as the effort on analysis of building and fire codes and practices is concerned, what is of greatest interest to us are the design and construction practices for the towers and WTC 7, especially the new and innovative design features, technologies, and materials that were used, the passive and active fire safety systems. And by passive, we talk about fireproofing, and by active we mean the sprinkler, fire alarm system, and communication system; emergency access and egress systems at the stairwells and elevators; and the structural and other fire safety modifications, inspection and maintenance, especially those that made after the 1993 bombing event.

As part of this overall effort, we've completed, at this point, a preliminary comparison of the then current building regulatory and code requirements. Specifically – why we've done that, comparing simply, the requirements of the code, it's not what was actually done on these buildings. Why we've done that is because it provides a context for us to study what was actually done for the buildings. So we want to compare different codes. And we've completed a preliminary documentation of the fuel system for the emergency power in World Trade Center 7.

Now the specific codes we have compared are: The 1968 New York City Building Code, the 1965 BOCA Building Code, and BOCA is a national model building code, which is now part of the International Code Council's International Building Code. The 1967 Chicago Building Code, because Chicago, in many ways, is similar to New York; winds dominate the designs, no earthquakes. The 1964 New York State Building Code. So, we have a city code and a state code. And the 2001 New York City Building Code.

What we have – there's a more exhaustive – comparison; information that's on our web site. I'm just trying to highlight here just a few features. First of all, to compare the relevance of the information I'm going to present, it should be recognized that the Port Authority adopted the 1968 New York City Building Code for the final design of the towers and World Trade Center 7. And that was consistent with a memorandum of agreement with the New York City. Designers are allowed to use acceptable engineering practices with approval of the Port Authority where code provisions were obsolete. That's a 1960 decision of the Port Authority.

And we will be reporting to you in a future briefing on what we have found with regard to how the Port Authority adopted and implemented that policy. But at this point, we have found that all five codes reviewed have similar wind pressure distributions, especially for tall buildings over 1,000 feet. There's a slight difference for the BOCA, the national building code, or national model code, which has a larger base shear. But, again, it's not substantial.

Also worth noting is that New York City introduced progressive collapse resistance requirements by rule in August of 1973, and I think the relevance here is that it was introduced after the towers were built. And the 1968 New York City Code reduced the fire resistance ratings from the 1938 Edition. Which, by the way, was operative until December '67, I believe, or something close to that, and the 2001 Edition reduced further from 1968. And all I'm showing you here are the hourly ratings that are required for columns and floors.

Again, the implications of this for building design, especially the towers, we will talk about later, but what needs to be kept in the background here is that sprinklers have been introduced since that time. Specifically, when the 1968 code was developed and adopted, sprinklers were not required in the upper parts of tall buildings. So the World Trade Center towers did not have sprinklers on the upper floors. So the reduction between 1938 and 1968 was not directly a consequence of sprinklers being put into the buildings. However, between 1968 and 2001, sprinklers have been included, and they do provide a level of protection, in addition to the passive fire protection of structures. So we will talk a lot more about this in future briefings.

We're also looking at two other aspects of – in this project, the active fire protection system, specifically the sprinkler system, the fire alarm system, and the smoke management system. But what we want to try and do is document the design, the capabilities, and performance, and to see what – to explain how they performed on 9/11. And clearly, again, if the water was going to be cut off, what the consequences of that would be, and what the capacity of these systems are. So it will be a complete study. And that work is ongoing.

As a part of that, we've completed a review of the history of postoccupant fire incidents in these buildings–the towers. And we have identified events that were large enough to activate more than one sprinkler, or if sprinklers were not present, events judged to be equivalent. Now, I should say that sprinklers were retrofitted in the towers after they were built. And we will report to you later on the exact dates when this was done. But it was sometime in the 1980s that the sprinkler systems were put in.

We've also looked at the fire history of the buildings by reviewing a number of documents that we have received from the fire department of New York, Bureau of Operations fire reports, and the Bureau of Fire Investigation records. Much of the Port Authority documents were lost in the buildings. We have identified 12 significant fires, as I've previously defined, that activated multiple sprinklers, in addition to the well-known 1975 fire that started on floor 11 of World Trade Center 1, and the 1993 parking garage bombing.

So that's a summary of where we are. And as we start formulating our safety recommendations, based on our findings, let me just point out a few things that we will be considering. Our recommendations will be based on our findings, and our hope will be to enable safer buildings, enhanced safety of occupants and of first responders, and improved evacuation and emergency response capabilities. We will try to distinguish, and we intend to distinguish, unique circumstances related to the terrorist attacks from the more common building and fire safety issues that cut across for all buildings, or all tall buildings. And our emphasis will be on performance-based solutions and not prescriptive solutions. And much of our recommendations that we expect to be prudent and practical recommendations that address the critical issues that are being investigated.

Finally, I just want to conclude with the purpose of the public meeting and the contact information. We look forward to hearing your input. This is all I was going to plan to say. The rest of the day is yours, for you to tell us, and provide us input on these three questions. Thanks very much.

Dr. Hill: Thank you Shyam. The next session is going to be the start of the public comments. If you have specific questions of Shyam about any aspect of his presentation or the investigation, we are going to have a Q&A session starting at 1:15, running to 1:45, and then another session later in the afternoon.

Some of you may have found in your folder that you didn't have a complete copy of Shyam's presentation. We apologize for that. If you have one or more missing pages, we are going to have extra copies available outside at the desk at lunchtime.

When we planned this meeting, we told everybody they would have between 5 and 10 minutes to make their comments. After we found that we had 24 people who preregistered, we communicated to everyone that they would have seven minutes to make their presentation. We have on the podium a light that will come on at six minutes. It's green when you begin, it'll flash red at six minutes, and then we ask you to please stop when the red light stays on at seven minutes. I apologize ahead of time, but I'm going to have to try to keep us on schedule because of the large number of people who want to speak today.

We are hopeful that you will focus your remarks on the information that we requested, specific technical aspects of our investigation, suggestions for things we could consider in one or more of our projects, and areas we should consider for specific improvements to building practices. We ask you to use the podium at the front of the room for making your comments.

We will begin with the first speaker, Sally Regenhard from the Skyscraper Safety Campaign.

Sally Regenhard: Good morning. I would – before I start speaking, please don't turn the clock on yet. I just want to say I'd like to give a special greeting to the families of the victims that are here today. I want to acknowledge my co-chair of the Skyscraper Safety Campaign, Monica Gabrielle, and my wonderful professional advisory panel of the Skyscraper Safety Campaign, some of whom will be testifying or presenting today, and some of whom will be observing. Thank you very much. And I'd like to acknowledge the members of the NIST for the fine work that you're doing.

My remarks today will focus on the skyscraper safety issues of 9/11/01. On 9/11, the cloak of competence was pulled off the City of New York. On that dreadful day, we found out how ill

prepared we really were, and this knowledge came at an awful price, the needless deaths of nearly 3,000 people, 343 of them firefighters, including my beautiful son, Christian.

On 9/11, the City of New York and the Port Authority of New York and New Jersey had no plan for terrorism, despite the fact that the Word Trade Center was previously attacked in 1993 with deadly consequences. At that time, the terrorist vowed to, “Return to finish the job.” And they kept that promise on 9/11.

The widespread failures in evacuation procedures, building code issues, and emergency communications became a prescription for disaster in the World Trade Center on 9/11. Despite propaganda to the contrary, the Port Authority, a bi-state agency which built the World Trade Center, and is totally immune from all local building and fire codes, really had no evacuation procedures in place at all. They said they did training, but the fact is that evacuation was left up to the individual tenants, not the Port Authority.

The majority of the occupants who survived felt that they were improperly trained or not trained at all. If they were trained, they would never have gone to the roof to try to escape. All those who made that crucial mistake paid with their lives. If they were properly trained, they would have known that access to the roof was impossible because of two locked doors that were only accessible to maintenance workers with keys.

The inadequacies of codes to ensure safety of persons in high-rise buildings became glaringly apparent on 9/11. In 2001, the New York City Building Codes, as well as all model codes throughout the nation, treated a 100-story building with the same guidelines as a 10-story building. This is no different today. No fire drills with full building evacuations were ever mandated and the WTC occupants were just as totally unprepared for a mass evacuation as they were in the 1993 attack.

New York City codes allowed a building designed to house 25,000 people to have only three staircases for emergency escape. It allowed gypsum board walls and stairways, which at the World Trade Center collapsed under impact and pressure, trapping fleeing victims. New York City Codes allowed many or all of the high-rise building stairwell doors to be locked, trapping fleeing victims when stairs collapsed and preventing firefighters from gaining timely access to floors where people needed to be rescued.

The unfortunate truth is that today very little has changed in the area of building code reform throughout our country, including few extra safety measures for high-rise buildings. But any discussion of the New York City codes is completely irrelevant to the WTC because these buildings were, and remain, above the law. The Port Authority's deadly building of unorthodox design and construction were totally immune from every single New York City building and fire code and were subject to, “The Port Authority's own codes,” which remain a mystery to this day because no one has ever seen them.

The Port Authority repeatedly claims that they, “Meet or exceed New York City codes.” However, history has shown that this is a falsehood. No high-rise building of 100% bar joist floor construction, before or since the World Trade Center, has ever been allowed under New York City standards and practices. According to the NIST WTC investigation, there is no evidence that fire tests were ever done on the fireproofing of the World Trade Center. This is a glaring example of lack of code compliance, to say the very least.

Finally, the untested fireproofing was grossly inadequate, a clear violation of New York City codes. However, since no FDNY violations can be issued to such an immune building, no code violations were ever served on these dangerous buildings. Indeed, the FDNY has no jurisdiction in the World Trade Center, but paradoxically, they were required to risk and eventually lose their lives in these building. What a disgrace, what a crime against humanity.

Since 9/11 we're moving in the direction of change, but far too slowly. Generally, we are crawling instead of running towards change. One outstanding exception to the situation is the New York City Department of Buildings and it's World Trade Center Building Code Task Force, which is affecting sweeping change and reform for New York City's Building Code. In February of 2003, this proactive New York City agency approved comprehensive safety measures, such as the temporary outlawing of bar joist floor assemblies, commonly known as truss construction, which characterized the World Trade Center, in high-rise buildings. The hardening of cores of staircases and elevator banks and the retrofitting of sprinklers in older buildings, and other safe guards, which hopefully will be incorporated into The New York City Building Code.

The New York City Department of Buildings awaits the findings and recommendations of the NIST investigation to enact further safety measures. I can only hope that the NIST recommendations will prove to be proactive, courageous, and historic in setting standards for building safety in this city and in this country. But there is still unbelievably widespread resistance to national reform. This was evidenced in the recent failures of a codes group to initiate basic fire safety reform through the widening of staircases for new high-rise buildings.

For example, the National Fire Protection Association recently had the opportunity to affect code change of widening staircases in newly constructed skyscrapers by one foot. A foot that could save many lives, yet they failed to do so because of the protests of special interest groups, specifically, and unbelievably, the General Services Administration, the GSA, a governmental agency who was supposed to advocate for the people of this country, opposed the widening of staircases in high-rise buildings. Another group that opposed this was the Building Owners and Managers Association, or BOMA.

A huge outcry in the building safety field led by the SSC and others has resulted in the revisiting of the wider staircase issue. At a recent meeting with the NFPA, the Skyscraper Safety Campaign was reassured that this most needed reform will be enacted in the near future.

Dr. Hill: Sally, can you wrap up, please?

S. Regenhard: We watchfully wait for this essential code reform to become a reality, and we urge the NIST investigation to reinforce the necessity of this most basic of safety reforms, wider staircases for high-rise buildings, throughout the United States.

Dr. Hill: Sally, thank you.

S. Regenhard: Okay. I just have – I have a few more sentences.

In closing, keep in mind that no reform codes and no method of enforcement will be of any value to safeguard the American public unless there is a system of accountability and responsibility in place. We need this for the effective safeguarding of human life in all buildings, and especially for the failures of the World Trade Center on 9/11.

There was a wholesale betrayal of all those in the World Trade Center and all the rescue workers who ran into a hopeless situation with radios that did not work. The former Mayor, Fire Commissioner, Police Commissioner, as well as the Port Authority officials are some of the individuals who must be questioned by the NIST investigation regarding what happened in the World Trade Center on 9/11.

Finally, without a system of accountability and responsibility for all public and private buildings, there will be no real impetus to change the system like the one that characterized the City Of New York and the World Trade Center on 9/11. Thank you.

Dr. Hill: Thank you, Sally. Please make sure we have your written comments so we can catch those things that you didn't have a chance to say.

The next speaker is Patricia Lancaster from the New York City Department of Buildings.

Patricia Lancaster: Good morning. I'm honored to be here today to talk about New York City's efforts to enhance the safety of high-rise buildings after the events of 9/11. The threat of terrorism is a sad comment on today's society. Almost two and a half years after the 9/11 attacks, the sense of unease remains as we go about our daily lives. Americans remain wary of anyone and anything that they suspect may be connected to terrorism. People are looking to the government to be more responsive to these fears and concerns.

New York City has responded to those fears and concerns in several ways. Many departments, including mine, have developed their own emergency response teams to deal with our large-scale emergencies. Using federal grant monies, and in collaboration with the Office of Emergency Management, we're working on a comprehensive agency emergency readiness and response plan. We retained an emergency planning and coordination consultant with national and international experience called Ecology and Environmental, Inc., who's working with the Office of Emergency Management in developing its logistics plan.

In addition, various city agencies conduct regular tabletop and field exercises dealing with terrorism scenarios. This summer, the Buildings Department staff held a tabletop drill that tested our ability to perform rapid structural assessments at multiple locations under extreme emergency conditions. I'm pleased to report that our staff met expectations in all areas of crisis response, including resource mobilization and deployment, damage assessment, remediation, and stabilization. However, it's one thing to improve our ability to respond to crises. We still need to consider the built environment to make it less vulnerable.

In March of 2002, we formed the World Trade Center Building Code Task Force. The Task Force comprised representatives and experts from the public and private sectors, including the building industries, the design community and real estate interests. They received input from academia, the special needs community, and the 9/11 victims' families and survivors. They sat down and hashed out issues encompassing structural concerns, evacuation and egress, fire protection, and mechanical system. And much as NIST is doing today, we did our best to obtain a wide spectrum of information and opinions. As part of our process, the Task Force held a public forum to hear testimony from the general public and other concerned parties.

The Task Force formed 21 recommendations, and we've formulated 13 of them into legislation which is before the City Council, as we speak. Intro 580 is presently pending, and a hearing is scheduled on February 24th. There are eight recommendations that the fire department emergency response communications in high-rise – I'm sorry. There are eight recommendations

that are not in the legislation, including: The fire department emergency response communications in high-rise building be enhanced, a building card listing the building's vital features, and that fire safety directors be given additional responsibility.

Regarding these three recommendations the fire department is still studying what type of emergency response communication is most cost efficient and effective. The other two recommendations are in the process of being implemented by a fire department rule proposal. Another recommendation is that New York City consider the adoption of a model building code, and we have 395 people on 13 technical committees that are in the process of doing exactly that. Most of the proposals that form the substance of the bill fall into three broad categories. First, there are retroactive requirements. Second, there are construction materials and methods that will be banned on all new work on high-rises. And third, there are new requirements as opposed to prohibitions applicable to new work on new high-rise office buildings.

In the retroactive category, let's start with sprinklers. Since 1984, new constructed high-rise office buildings must be fully sprinklered, but many older buildings in the city remain unprotected. This bill would require that all owners of all existing office buildings over 100 feet in height that are not already fully sprinklered, will be required to be sprinklered, but within 15 years.

The next three retroactive requirements deal with emergency egress. The clarity or readability of the egress path is essential for a successful evacuation. The many new exit signs and markings installed in the World Trade Center after the 1993 bombing were credited with helping to speed evacuation on September 11, 2001. New and existing high-rise office buildings will be required to install markings that are photo-luminescent beginning January 1, 2006. Another retroactive requirement is the installation of signage in stairwells of all existing high-rise office buildings where the exit path may not be clear, and this happens more than you'd think. Our bill also mandates the installation of backup power to illuminate exit signs in certain pre-1984 buildings to provide extra protection.

On the topic of evacuation, it's important to note that existing laws and rules only address the evacuation of office buildings in the event of fire. They do not address non-fire-related emergencies. The Task Force proposal empowers the fire department to require evacuation planning drills for non fire-related emergencies in all buildings of 75 feet or higher. We are prohibiting scissor stairs and we are involving elevators in a better safety system, whereby, in smoke conditions, they will be required to have smoke stop elevators of the vestibule.

The task force legislation also addresses the need for sprayed on fireproofing to remain viable throughout the life of the building. To address this, the proposal requires controlled inspections by a registered architect or licensed engineer. Finally, the building code has for many years required that any mechanical ductwork passing through a fire-related wall include a damper that drops shut when a fire is detected. Now we're requiring that a controlled inspection by a registered architect or licensed engineer is done with the new ventilation systems are constructed to ensure that these dampers are correctly installed.

Even with proposals of this scope and depth, and by the way they're all available on our web site at nyc.gov/building. Even with proposals of this scope and depth, there are still some areas where we look to NIST for technical assistance.

Dr. Hill: Could you wrap up now, Patricia?

P. Lancaster: I sure will, thank you.

I've already mentioned open web steel joists. We also seek your expertise in the areas of impact resistance, progressive collapse, stair width, and fuel oil storage.

I can assure you that the Building Department has received widespread support in our effort to enhance building safety. The World Trade Center Building Code Task Force was one of the most significant undertakings of the Building Department. Combined with our effort to adopt the International Building Code and to streamline the building process, our work will keep New York among the safest cities in the world. Thank you for your time.

Dr. Hill: Thank you.

Next we'll hear from Jim Tidwell representing the International Code Council. Jim?

Jim Tidwell: Good morning. My name is Jim Tidwell, and I'm the National Director of Fire Service Activities for the International Code Council. I'm also a 30-year veteran of the fire service having served in metropolitan fire departments for some 30 years, serving in virtually every capacity, including Chief of Department and Fire Marshal.

First, I want to thank NIST for all the work that's been done thus far on the study of the World Trade Center collapse. It's my opinion that NIST is perfectly suited to this mission. NIST is able to sort through the technical issues and put them in the proper perspective. I know that NIST will hear from many people and organizations about their individual perspectives, and I'm sure that they will continue to accept those comments and utilize them in their final report. And for that, I'm grateful to NIST. Thank you.

The reason I'm here today is in support of those efforts. As you know only too well, the study is only the first step in the process. If it sits on a shelf and is not put into practice, we will have wasted many resources and a lot of time. I'm here to encourage you to search for the most effective way to assure that the United States citizens receive full benefit of the work being done. And one way to do so is to make sure that the regulatory documents developed and used in this country benefit from the knowledge flowing from your study. The International Codes are more widely adopted than any other set of building and fire codes.

The International Building Code is now adopted at a local or state level in 44 states. Last year, more than 600 jurisdictions adopted the International Codes, including the Department of Defense, and the State Department has selected the International Building Code as the regulation they will use to construct embassies worldwide. It's these codes that will bring life to the study. These are the regulations that will utilize your information to its greatest advantage to the American people.

And I have a few suggestions. Because NIST is not typically active in the code arena, and don't support, necessarily, code changes, I think it would be helpful if you partnered with one or more organizations that are active in the International Code development process. The International Association of Fire Chiefs has recently formed a fire and life safety section. This group is gaining momentum as the Fire Chief's voice in fire prevention. They're already more active in the regulatory arena than any other fire service organization on a national level. They participate in all of the national code processes, and their primary focus is the safety of the public in general, and first responders in particular. Without a financial stake in the outcome of these regulations, they have become a highly credible and influential advocate for fire safety.

Another group that's active with us is the National Association of State Fire Marshals. As the Chief Fire Prevention Officer in their respective states, this group has also been a beacon to those of us interested in improving the appalling record of this country as it relates to fire safety.

I'd be more than happy to serve as a conduit between NIST and the fire service, if you so desire. If you choose not to take me up on the offer, I sincerely hope that you'll take advantage of the existing organizations and their desire to avoid an event of this magnitude again. Thank you.

Dr. Hill: Thank you Jim.

Robert Solomon, representing the NFPA, National Fire Protection Association.

Robert Solomon: Good morning. As always, NFPA appreciates the opportunity to participate in today's public hearing and to respond to NIST's request for comments on the status of the World Trade Center study.

NFPA's technical committee members, approximately 6,300 of them are association members, and even the staff, have a common interest in what the NIST study will ultimately tell us about performance of buildings under extreme or extraordinary circumstances. From the very beginning of these events, NFPA's involvement with the FEMA, ASCE, building performance assessment team, some work we've done on assessing impacts on first responders, or considering some changes, preliminary changes to the NFPA codes and standards marks only the beginning of a comprehensive initiative to further enhance public safety. As always, NFPA will do all that we can to make necessary and reasonable changes to NFPA codes and standards.

NFPA believes that the exploratory and analytical direction that the federal building and fire investigation of the World Trade Center disaster, the direction it's heading, is wholly appropriate, given the magnitude of the event. This is, in our view, the most complex building loss investigation, obviously, ever conducted in the world.

We believe the investigation is on track to deliver answers to the many questions that have lingered since September 11, 2001. It is imperative, however, that any specifically identified, needed improvements to codes, standards and design guides, be distinctively highlighted in the final work product from Dr. Sunder's team. This will ensure that the concerns are addressed in the appropriate venue. At the end of this process, philosophical, conceptual, or idealistic recommendations will provide little value. Instead, realistic, specific, and precise recommendations from the study team must be forthcoming if we are to derive the full benefit of the work of the World Trade Center investigation.

I have four items I just wanted to note that I picked up during the presentation this morning and also while reviewing the December 2003 update. I think one of these items, we want to make sure the study is clear on is terminology. The handout this morning, the presentation, versus the December update, terminology issues on composite floor truss systems versus composite bar joist floor systems. I think it'll be very important for the consistent use of terminology for those two types.

Both documents refer to major emergencies. I know that anything NIST can do to help define what includes a major emergency, that guidance given there.

Number three. In the item I saw in the handout in the presentation, the justification for selection of more than one sprinkler activation criteria, I would almost wonder why we don't go back and look at even single sprinkler operation criteria for certain fires.

And then I think the fourth item that I have here is one that we are still struggling with at NFPA, where we refer to making buildings safer. And the question is safer from what, and safer for how long?

The process and infrastructure to manage the forthcoming recommendations is largely in place. In order to further refine and strengthen those issues which will affect future editions of NFPA code and standards, particularly those related to NFPA's fire, life safety, building and construction codes, disaster management standards, first responder, and public education issues, NFPA is announcing the formation of an advisory committee on high-rise building safety. Such advisory groups are appointed on occasion to help set the agenda for specific topics within the NFPA system. In this particular case, the system extends well beyond codes to our role in the public education arena and the research field.

This advisory committee will be charged with studying subjects as diverse as nontraditional egress contrivances, elevator use during building emergencies, redundancy criteria for water supplies for fire protection systems, and fire assistance rating criteria for structural elements. This group will serve in an advisory role to the appropriate NFPA technical committee on a particular or given subject. In addition, the scope of this committee specifically declares that committee members are to be charged with introducing recommendations from the NIST federal building and fire investigation of the World Trade Center disaster into the NFPA codes and standards process.

By establishing this knowledge body now, NFPA will be well prepared to begin to implement technical changes to our codes and standards in a timely manner, once the conclusions and recommendations from NIST are finalized. NFPA looks forward to reviewing the final studies later this year, and we continue to applaud NIST, and especially the work of Dr. Sunder and his team, for the talent and resources that is put forth in this effort. Thank you very much.

Dr. Hill: Thank you, Robert.

Jack Murphy, The New York City Fire Safety Directors Association.

Jack Murphy: Good morning, and thank you for the opportunity to speak today. The Fire Safety Directors of Greater New York have been an advocate for high-rise fire safety in New York City for more than 25 years. We support the need to incorporate new technologies for new construction and increase life safety best practices to existing structures, so as to better serve both the public and first responder. We therefore recommend to NIST, to regard as new technologies and best practices the following high-rise building improvements. Because of time constraints, I'll only go over and highlights certain ones.

One, for new construction: Erect at least one stair tower as a fire tower with the provisions to the exterior atmosphere to better assist an evacuation from a fire or chemical incident within the building. Widen stair landings so as to facilitate a rest area for occupants, as well as provide an area of refuge for disabled people. Install at least one elevator bank that is resistant to water damage, free from electrical shunt trips, and cable smoke mitigation or provide a separate elevator with the same amenities remote from the main lobby that may serve the purposes of a

VIP and/or the fire department use. I emphasize VIP. This way we know the elevator is used. Augment the building structural support systems with fireproofing materials and application methods so as to ensure a long-term bonded adherence. Enclose all public elevator lobbies, except for the main level, with fire resistive constructive materials. Install a rescue air system for the fire department to use as a means to provide a refill of their cylinders within the building.

Limit an open area space to 5,000 square feet. Now, this is a two-fold fire protection process. One is to address the smoke generated in fires by limiting toxic smoke levels of smoke to a confined area, so as to provide the occupants with a safer evacuation environment. And the other is that in many high-rise fire buildings, after the fire department has made several aggressive fire attacks and it is halted, not because of the fire department's efforts, it is because of the intense heat and flame that's given off from these large, open areas. It is beyond the fire department's capacity to push down a hallway and make an effective extinguishment. Therefore, a defensive position must be taken, either in the stair tower or the floor below. Until the fire consumes most of the floor content, and before making another aggressive attack push on to the floor, by finding a better way to devise a balance, and I emphasize a balance, between active fire protection systems and passive fire protection systems in high-rises, many of these all-risk situations will diminish.

For existing buildings, conduct a real-time case study for a full building high-rise evacuation that is inclusive, but not limited to, fire department flex time to reach the emergency incident floor during an occupant descent down the stairs. The use of elevators for an all-hazard emergency evacuation, other than fire, and to take a look, a strong look, at security impediments which have grown up into the building, reducing egress paths et cetera. There are a lot of things out there.

For both new and existing buildings, we're looking for the most important vital building emergency voice communication center, is the fire command station or center in the building. The present fire command center location in the building exhibits a vulnerability to an assault within the open areas of the lobby or atrium space. This vulnerability must be addressed. For new construction, fire command centers need to be in a glass protected room, with the fire department accesses from the outside. For existing fire command centers, methods must be devised to reduce their exposure risk in these open areas.

All stair tower doors, and I emphasize all stair tower doors, except the street level, are to be accessible from both sides of the door for any all-hazard emergency evacuation. Enhance a stair tower means of egress with photo-luminous signs and striping. Develop a maintenance and inspection standard for fire and smoke-resisting construction, modeled after the NFPA 25.

And one of the most important objectives on how to best execute an emergency evacuation plan begins with an essential, but human foundation, a dedicated fire safety director in these vertical cities. A person who understands the occupants behavior during an emergency, the fire protection features within the building, the building systems themselves, and can make critical evacuation choices for various all-hazard threat levels that are unfolding within the building, and these days, within the neighborhood that surround the building. And this is quite evident recently in the Chicago fire that just took place. Enhance local fire department radio communication capability for portable radios within the structure. The authority having jurisdiction must approve such installation.

And in closing, these proposals are not limited to the broad range of new technologies and best practices, suggestions that will provide future high-rise life safety standards, with greater

flexibility to the growing need that has, within such menacing sadness, alerted us to a response with a determined purpose. Thank you very much.

Dr. Hill: Thank you, Jack.

Our next speaker will be Bill Bowen.

Bill Bowen: Thank you. I want to thank the committee for providing this opportunity to talk. I think it's very needed.

In 1993, February of 1993, during the first attack on the World Trade Center, the Fire Department of New York City found out that its radios did not adequately work. Those Motorola Saber 1 radios would not relay communications from the street to the firefighters in the building. New York City, which has the largest and most modern fire department, was reduced to using foot runners, similar to what they did a hundred years ago.

The question that begs to be asked is how could that same fire department have been using those same radios in the same location on September 11, 2001? And they were. And a bigger question arises. How could that happen when they had just paid somewhere in excess of $14 million for new radios that were not available to them that day, because they'd been found to be so inadequate? The radios that they purchased were never tested. Not before they were purchased nor were they compared to other radios nor were there competitive bids. When those radios finally were issued, March 14, 2001, the new radios, they had so many problems that we have compiled lists, of memos, and documents that came from firefighters, lieutenants, captains, deputy chiefs, battalion chiefs, assistant chiefs, detailing the problems of those radios, and they were submitted to the administration of the fire department, who took no action.

A firefighter in Queens nearly died and a hearing was then called. At that hearing, former Commissioner Thomas Von Essen reiterated that these were good radios. And an investigation that we conducted, myself, and when I say, we, I'm talking about the person who asked me to come in, who was a high-ranking officer in the FDNY, who's identity will be revealed soon. Internally at Motorola in Florida they refer to these radios that Thomas Von Essen called good radios, as Kramer. So-named after the character on the Seinfeld television show because there were so many problems with them.

At that hearing, on April 10, 2001, before the City Council, Thomas Von Essen and the Chief of Operations, Daniel Nigro, said that the only problems with those radios, the new radios were echoes and delays. That's all, just echoes and delays. Three weeks before at Von Essen's insistence, Chief Nigro had written a memo pulling those radios, and he said there were so many problems reported, but the predominant problem was unreceived messages. Flatly, when firefighters used those radios, often times they couldn't be heard. Not a good situation.

Those radios were pulled from service one week after being issued. One week, $14 million plus, worth of radios. They were reconfigured, they were dumbed down from digital radio to, in a sense, UHF radios, which were then issued sometimes in 2003. And how have those radios worked since then? We've located memos from within the FDNY that say that when those radios are keyed to transmit, they'll knock out the thermal imaging camera that firefighters use to spot fires in the wall or to spot the bodies of potential victims. And that it knocks out and makes the alarms go off on the CO meters, which measure CO_2 in a building. And the advice in the memo from the fire department says, turn off your radio before you check for CO_2 in the

building. So, I guess if you get an evacuation order, you don't get to hear it. Because that's what happened on 9/11.

If an urgent order gets issued, and this has also happened, and it's not heard by the other firefighters in the building, you can say good-bye to that firefighter, because nobody's going to hear him. And if you want to know if it was somebody's radio that set off your CO meter, you can't call him on your radio to ask them if they transmitted, because your transmission could set off the alarm on their meter. That's not a tolerable state for the radios for the largest fire department in the world.

Motorola is aware of these problems and they have been. When asked about the investigations called by the fire unions, former Mayor Rudy Guiliani said this is not about reality, this is because the union is bitter over the fact that Commissioner Von Essen had to discipline a few people and they are being petulant. At that same time in Los Angeles where I live, there was a Grand Jury investigation going on into Motorola digital radios. A spokesperson for Motorola was quoted in the Los Angeles Times as saying that these digital radios were never intended to work inside high-rise buildings.

Recently, along with many other internal memos from Motorola, we were supplied a memo. This memo says, and bear in mind, this is about a radio called the XTS 3500. This is the one that they paid $14 million for, was in the field for one week. At the time that was being reintroduced, this memo says, the FDNY must move off the XTS 3500 platform, $14 million, one week, they have to get rid of it. Did we sell them the wrong platform? Did we oversell the fire ground? Did we ignore these to keep a $10 plus million order? They talk about switching the FDNY to a new radio. They talk about preventing Kenwood, their competition, from being able to bid.

When Commissioner Von Essen was asked about these radios, after the firefighter in Queens almost died, he said that Boston and Chicago were using these radios. I want to state this clearly. He lied. That was a lie. I'm not qualifying that. That was a lie. When then, Comptroller Alan Hevesi demanded that Motorola tell him which other large departments had ever used this radio, he was told by Motorola they could not divulge that information because of confidentiality. The Senior Vice President for Motorola, Ken Denslow, before the City Council, then admitted the New York City Fire Department was the first city to use those radios. They effectively turned 11,000 firefighters into guinea pigs.

Dr. Hill: Bill, can you wrap up, please?

B. Bowen: Yes. This brings me to what is the most distasteful part of this whole matter. Recently a memo came out from the fire department to let the firefighters of New York City know if they talked to the media or even a government investigation about information that they have, they can be fired. Well, what is that?

We feel that members of the FDNY were not protected on September 11th, myself and my co-author, when they were sent into the Twin Towers armed with those old radios. Their families have been denied some of their legal rights in order to protect some business interests, but that protection should not be extended to companies, and will not if others find out about the knowledge of the problems with these radios. On September 11, 2001, New York lost 343 of its very bravest, 60 of its finest, and thousands of its citizens. That must never be allowed to happen, again.

Dr. Hill: Bill, can you stop, please?

B. Bowen: I can stop.

(inaudible)

Dr. Hill: Yes, go ahead.

B. Bowen: Thank you. Thank you very much.

Dr. Hill: Please.

B. Bowen: What those people lost, the city must never be – those guys must never be put in that situation again, where they're asked to risk their lives to save others, which they do every day. And when the events turn bad, when the situation turns deadly, and they expectantly turn to the communications devices that their department supplied to them, to talk to the outside world, they've got to know, know beyond any certainty, that their orders to evacuate or their cries for help will never again be met with radio silence. Thank you very much.

Dr. Hill: Thank you Bill.

The next speaker is Jim Quintiere from the University of Maryland's Fire Protection Engineering Program.

Jim Quintiere: That's a hard talk to follow. I think there should be more people with that passion and that dedication to find out the facts and to have the courage to state them. And, I don't know the man, so I wasn't asked to say that, but I think there's a lesson in that for NIST in its investigation.

How soon we forget after disasters like this. I think if you look at 9/11, the impact that that had on everyone here and in the world, is really, I think, due to the fact that the buildings collapsed, and then took the lives of those people. So as far as I'm concerned, this investigation that NIST is conducting is to principally find out why those buildings collapsed and what the problem is.

Initially, we had some kind of faulty, you know, very timid kind of investigation. The ASCE went forward first, the FEMA group funded them, belatedly, and NIST started getting involved. They used some of their own funds. I give them a lot of courage for doing that. And then they got $16 million through the House Science Committee under Congressman Boehlert, probably due to the lobbying of the Skyscraper Safety Campaign ladies, Sally Regenhard and Monica Gabrielle. So NIST has been involved in this for about 2 1/2 years now. And so, we really need to look at that process. And that's what I want to talk about.

Now, in the midst of the World Trade Center investigation, we have suffered the agony of a dramatic space vehicle failure and the loss of life in Columbia. That investigation, also launched under the auspices of the House Science Committee, has had a different cast, at least to my interpretation. Here we had a space vehicle fail on re-entry, due to a breach in its insulation and hot hypersonic gases eroding the vehicle. Not so dissimilar is the World Trade Center, but here the eyes of the victims and the world watched it unfold, and here fire penetrated the supporting steel insulation.

In the World Trade Center collapse, we still lack an official cause, albeit, NIST says that they may have four or five scenarios listed in the order of probability by the time their report is published. In Columbia, a government scientific committee sifted the evidence, held hearings, elicited testimonies, focused on the probable cause, did a first order analysis, and then conducted tests to prove it. Indeed the Investigative Board, and this is a quote, "determined that a foam projectile with a total weight of 1.67 pounds at an impact velocity of 775 feet per second would best represent the debris strike," and then, this was based on simple physics. And then they did a test to show what would happen. They let the process unfold in the media and pointed the failures directly at responsible areas. This is a model of what I think a public investigation should be, objective, and I think there is some contrast in this to the way the NIST process is unfolding. And with all due respect to my former colleagues at NIST, it may not be solely their fault.

The NIST has created, to my seeing, a technical bureaucracy in this investigation with no clear person as the spiritual and technical leader of it. I get comments from those working on it, that they can't say, they say they can't tell us what's going on. And I also get comments that, "I've done my job, and I've passed it on to someone else to use." I fear at the end that we will get a report, bound in many volumes, blurting conclusions, and lacking in focus. And many authors saying, I did my job.

Now, I've been involved in many investigations, and I can assure you that this is not the model. One might say that, what can we expect when the Commerce Department is virtually controlling the process with what I see, a legal stranglehold. Usually the role of lawyers and litigation investigations are to fight to obtain data in a timely manner. It would be far better to get a few dedicated, objective scientists to examine the facts, develop findings on their own initiatives, as NIST has successfully done in the past investigations. I am not sure good scientists can behave as investigators under the control of the Commerce Department.

Let me make some specific comments. On witness testimony, and investigations starts with witness statements, and then sworn testimony in hearings and deposition. NIST is still waiting, or just about now, collecting information from these interviews. Photographic evidence: NIST has done an excellent event reconstruction, it would appear, in the documentation of events and times from photographic and video records, Shyam Sunder talked about that. This information is completed and should be made public now. It is factual, it is a compilation, and there's no need to wait for an extensive NIST review process before making it public. It should be placed in the public domain now for scrutiny. Indeed, it's the timeline that should be the primary driver for the NIST analyses and focus of their conclusions. That evidence should drive the other analysis. It's not backwards. It's not that the analysts now have to see if they agreed with that. I mean, you've got to put that first because that's factual.

If we look at the predictive methods NIST are using, they're very impressive. They appear to be mostly relying.... And I say appear, because a lot of this is not in the public domain. We have to wait for a final report to see really what they're doing. But it appears that they're using sophisticated computer simulations for predicting the impact of the aircraft on the structure, the behavior of the fire, and its thermal effect on the structure. These analyses give impressive video renditions of the phenomena. Indeed, the New York Times devoted a two page article of similar calculations done in litigation of the World Trade Center collapse. Yet those results suggest great inaccuracies, as the South Tower falls in this simulation on impact, and we know it didn't.

These calculation methods represent the advanced state of modeling, and we are – and are still the subject to much research. If they were so reliable, the aircraft industry would solely design and build airplanes without the use of wind tunnels. NIST shoots itself in the foot, in my opinion, by advocating the sole use of these models, and therefore cutting itself off from asking Congress later to support the necessary research to make them more accurate. Most design and investigative efforts start with focused first-order analyses, many of which rest on experimental correlation. Such alternative engineering methods need to be part of the NIST predictive modeling approach. Indeed, it appears to have been part of the Columbia investigation.

Dr. Hill: Jim, I won't cut you off because of the nature of your comments, but please try to wrap it up.

J. Quintiere: Okay. I'll just say, there are some clear areas of scrutiny in the NIST investigative effort, namely: The South Tower fell in about 56 minutes and the North in about 104. The North had double the insulation. You don't have to be a mental giant to realize the correlation there. A heat transfer analysis of the truss rods, the weakest link in the structure, yield similar failure times. Two independent United Kingdom analyses show the role of the floor truss in the failure mechanism. The NIST photographic evidence shows the necessary floor deflections to support these theories.

NIST plans a test of the floor truss system in a standard furnace test. It is well known that these furnaces tests offer uneven results. In other words, one furnace test does not necessarily agree with the other. And they do not represent a real fire. So if you do a test and it says you get a three-hour rating, that doesn't mean it corresponds to three hours in a real fire. And if I had more time, I could tell the technically inclined in the audience why. So NIST has the obligation to scrutinize these areas and reach complete, independent, and supportive conclusions.

Dr. Hill: I would appreciate, Jim, if you could wrap up.

J. Quintiere: And I'm closing right now, and that's my last statement. Thank you very much.

Dr. Hill: Okay. Thank you.

Next will be Professor Astaneh from the University of California at Berkeley.

Professor Abolhassan Astaneh-Asl: Thank you very much. First I would like to thank NIST for providing me with the time to speak to you today. I'm Professor of Structural Engineering at the University of California, Berkeley. However, I'm speaking today, I only represent myself, and do not represent any agency, entity, or organization.

After 9/11, I have been involved with investigation of debris from World Trade Center. Later, I testified before Congress, Committee of Science. And since then, after receiving drawings from FEMA, have been doing limited and unsponsored analysis of impact of the plane on the World Trade Center's North Tower. Today I will make comments on the NIST studies, based on what I have learned so far from our studies, as well as based on review of the minutes of the NIST NCST Advisory Committee meeting.

My work on the World Trade Center is dedicated to the memories of all victims of 9/11 attacks, and to the firefighters, police officers, and other first responders who so heroically sacrificed their lives to save others. They went up to save them, and eventually many of them lost their

lives. I also like to pay special tribute to Skyscraper Safety Campaign for their monumental effort to make the structures safer. And as I mentioned 9/11, six hours after the tragic event, on PBS News Hour, I'd like to pay special tribute to Leslie Robertson who designed the World Trade Center to survive the initial impact, in my opinion, and now the opinion of many, has also been saving lives of thousands who escaped to safety before the collapse of the towers.

Our studies, as I mentioned, are limited and unsponsored. These are the people, excluding myself, many bright students and engineers and scientists from U.C. Berkeley and MSC Software Corporation. They donated to us very expensive software, and they donated their time to make sure we use it properly, and we used that software to do the analysis. I'm going to show a little bit of it.

This is the study we did, modeling the ten stop stories of North Tower, where the impact was, and the model, the floors, the joists, the connections, columns, exterior, interiors realistically. The only thing that we did not model is this slice of column. I'd like to show you a representative plane impacting the North Tower. I call it representative 767 because, not having the drawings of 767, we have complete drawings of 747, and we came up with representation of stiffness, mass, and other properties, which represent 767. So we impacted the North Tower and here is what you are going to see, as far as plane penetrating the exterior columns and entering the building, with almost no damage other than tip of the wing is broken and the tail rudder had some damage.

This is a real damage picture from North Tower, and this is our study as, Professor Quintiere mentioned, these are, of course, are all wonderful models. But all of it, I agree with him, should be verified by test results. I'll get to that in a second. What you're going to see is the same analysis, but the plane is entering from the side so you can see the – this is the west view of the North Tower. Basically what happens in this case is the plane enters, and these colors are stress level. Red is the fractured stress. Plane cuts through the floor, but the struggle results in a compression accordion fracture and failure of the fuselage, and then the nose hits the interior columns. The box columns do not fracture, but the wide flange columns at that level fractures without – with no, almost, resistance. And one of the engines cuts through the floor and drops into the elevator shaft. The other engine exits the building, as we think might have happened.

Finally, my comments: First, I'd like to commend NIST on their monumental efforts. Second, I would like to make specific comments on the ongoing investigation. I sincerely hope that these brief comments will be considered as personal suggestions on my part, at best, and constructive criticism, at worst. In no way, my comments should relay any negativity on any part of NIST efforts. My comments can be ignored entirely. If there is any interest, I will be happy to submit a more extended version of these comments with more elaboration.

First, modeling behavior of material and its structures and structural elements, especially connections, should include high-strain rate impact affects. As the previous speaker so eloquently put it, you can make any assumption and you can get any result, I guess, from our analytical models, but you need information about the plane rate and how steel performs under impact of plane. We don't have it. So, if you don't get it soon, your results will be just as valid as your assumptions, and it will be more of scenario rather than fact.

Second, there's a need for more testing of materials. Structural components also should be tested to establish their behavior under impact. From our studies, we believe that bolts, and we have seen this in previous studies of earthquake effects, the bolts fracture on very high

frequency impact very fast. And those bolts were there, and we believe that you should study them.

If the best minds and best equipped test laboratories in the nation are to be brought to bear on this investigation, in addition to government and private sector, the academic researchers and the university laboratories should be utilized more. The SAC projects of '96 – 2,000 in California is an excellent example model to follow for such collaboration. The NIST NCST Advisory Committee should be commended for their efforts. However, for the purpose of quality control of a project of this magnitude and complexity, there needs to be an independent, but less involved, modeling analysis to ensure that major errors and omissions are caught before the final results are relied upon. As a member of advisory committee for seismic stresses of a major long span bridge in California, I witnessed first hand the success of this approach through quality control, where the main team had actually major errors, and the independent team caught those errors and the final results were correct.

Finally, the ongoing design of Freedom Tower, now I shift to future, should incorporate the findings of this and other investigations of the collapse of the World Trade Centers. In addition to – in addition, and this is very important, I have been talking about this since 9/11, in addition, the design team of Freedom Tower should include fire engineers and fire marshals, as well as NIST representatives from the beginning of designs to ensure that the lessons learned from this tragedy are fully applied to the designs. You cannot be an architect, design escape route, without knowing that that firefighters can escape from – can go up from rescue route and save the lives of people. That has to be done now, not later.

Dr. Hill: Professor Astaneh, can you wrap it up, please?

Prof. Astaneh: Sure. There has been extensive discussion of our architectural aspects and appearance of Freedom Tower, however, the discussion of the structural and fire safety of Freedom Tower is left mostly to the features. In my opinion, these safety aspects should be given the highest priority over architectural aspects.

Thank you very much.

Dr. Hill: Thank you.

Prof. Astaneh: I'd like to finish this. I wish the structures were here today, and with them were more than 2800 of our loved ones who so violently perished on 9/11.

Dr. Hill: Thank you.

Next will be Lawrence Shapiro from the W.R. Grace & Company.

Lawrence Shapiro: Good morning ladies and gentlemen. My name is Larry Shapiro, the Worldwide Director of Marketing for the Specialty Building Materials Unit at W.R. Grace, and we're one of the leading manufacturers of spray-applied fire protection materials designed to protect steel structures from the effects of fire. I'm very pleased to be here today.

I'm very concerned about the state of building codes in the United States as they relate to fire safety. At a time, post-September 11, when I believe the public has assumed that fire safety codes must have been getting more strict, we've seen a dramatic relaxation of fire safety code requirements with the result, we believe, that buildings have become less safe instead of more.

Furthermore, while the code-making process should be transparent, science-based, and inclusive of the various viewpoints of all interested parties, we believe that the processes that were used to bring the codes to their current state should be examined, scrutinized, and that significant improvements are necessary.

One of the hallmarks of fire safety in buildings is the concept of redundant systems; alarms, lighted exits, sprinkler systems, compartmentalization and fire-resistant construction, all serve to provide time, time for occupants to safely exit the building, time for first responders to be alerted and to arrive, often through traffic-clogged streets, and time for brave firemen to enter the building to rescue occupants and extinguishing the fire. In the worse instances, fire protection measures provide time to clear the area, in the event of a collapse.

Three model building codes that have been used for decades describe these redundant systems. These old model building codes have been replaced, and are being replaced, with the new International Building Code and NFPA Codes, which make building design more uniform across America, improving productivity and the design and construction process, which is great. However, while it would be reasonable to think that the new codes would have adopted at least the minimum fire standards of the old model codes, when these new codes were released and examined, we found that the new codes offered levels of fire protection that were substantially lower than any of the previous model codes.

This was done, primarily by reducing the requirements for fire resisting construction techniques and passive fire-resistant construction materials and systems to favor sprinklers. Now clearly, sprinklers are a key safety provision in buildings, should be required as part of every balanced fire safety plan. However, pinning public safety on any one system exposes building occupants and brave first responders to risks that are unnecessary and unreasonable. Imagine buying a car without seatbelts because it has air bags, or flying in an airplane without redundant control systems. Any single safety system is susceptible to unforeseen events that may make it inoperable or insufficient to perform as intended. In fact, the fire situations could be described as often the direct result of unforeseen events. As such, it is prudent and reasonable to insist on redundancy and balance in our designs and passive, as well as active systems in our buildings to maintain public safety.

The decline in the requirements for passive fire protection systems under the new codes is not subtle. It’s not minor. As we examine the new codes, we evaluated a number of projects across America that were built under the old model codes to see what the passive fire protection requirements in these buildings would have been if they were built under the new codes, the code provisions that we're building under today. We believe the results were dramatic. Repeatedly, we found that buildings that had been required to have their structural steel skeletons protected from the effects of fire with two or three hour ratings, were, under the new code, requiring no passive fire protection at all. This analysis included medical buildings, assisted living centers for our seniors, and office buildings. That means in the event of an uncontrolled fire, steel in these buildings would be exposed to the searing heat of the fire immediately, making the structure susceptible to collapse.

So how did the codes get to this point? Well, after unsuccessfully making this case for balanced fire safety provisions, before public code hearings, I requested and was granted an audience with a senior member of one of the old model code agencies that was intimate with the development of new IBC. I asked him if he was aware that the new code required far less passive fire protection than any of the old model codes. He told me that he was. I asked him what the basis was for the relaxation of those codes to that extent. He was unable to articulate

the basis for the decision and could only offer me another question in response, “How do you know the old codes were right?” I think the cause of public safety deserves either better transparency or better science or both.

To ask the question, how do you know the old codes were right, I looked to our experience, thankfully infrequent, with catastrophic fires, and found the fire performance of the First Interstate Bank building, Los Angeles to be illustrative of the benefit of redundant systems and provisions for passive fire protection. The 12th through the 16th floors of a 62-story building, First Interstate Bank Building, L.A., burned for almost 4 hours. The sprinkler systems, which were not required when the building was originally built, and were in the process of being installed, were not yet operational. Despite 2,000-degree temperatures that gutted the effected floors, the structural steel maintained its integrity. The 50 upper floors that rested on the steel in the fire floors, withstood the heat for hours because it was protected with a durable, cementitious fire-protective coating that was applied 16 years before the fire, and was in place that day. That building was renovated and reoccupied without the need for any substantial structural repair. It stands today.

The relaxation of the requirements for passive fire-resistant materials and the resulting threat to public safety has not gone unnoticed in Congress. Senator Hollings from the state of South Carolina has written to the National Association of State Fire Marshals on this issue, with specific concern over two public schools built in his state that would have been protected for two hours under the Southern Building Code, but were, in fact, built with practically no fire protection, passive fire protection, on the steel under the IBC.

How do you know the old codes are right? That's a good question. The Partnership for Safer Buildings, a group affiliated with the National Association of State Fire Marshals, conducted a limited inspection program last year looking for indicators of the state of fire safety provisions in buildings built under the old model codes. The report can be viewed on the national web site. But they found a number of circumstances where passive fire protection had been dislodged from steel during the building use, and situations where building contents and wall configurations were, because of renovations, different than the original design. The partnership report concluded that in some of these cases the fire safety provisions, in their current state, could be insufficient to provide the level of safety envisioned by the original designers.

These values lead me to conclude that the old codes weren't right, and despite the fact that they did prescribe for redundant safety systems, they did not require inspection or maintenance during the life of the building. The new codes do not require this inspection or maintenance either, which is an area for improvement. However, the new codes make that situation more acute by their increasing reliance on single systems to provide public safety in the event of an emergency, thereby exposing that public to more risk than necessary.

Dr. Hill: Larry?

L. Shapiro: I appreciate the work that NIST is doing, and thank you for your attention.

Dr. Hill: Thank you.

Next we'll hear from Tim Vellrath from Vellrath Engineering.

Tim Vellrath: I am not a speaker. I’m a contractor. I applied the spray fireproofing that we talked about today.

On that fateful September day we learned – the world learned a lot about fire safety. Despite the fact that four people have mentioned fireproofing, I think it's been ignored for too long. No longer can we use ignorance about the subject as a defense. No longer can we say it's the other guy's job, it's not my problem. No longer can we go simply through the motions, we have to get it right.

Up to now, and I have no special sources or anything, from the TV documentary, it was determined or assumed that the plane crashes knocked most of the fire proofing off, and that's why it didn't work. I want to challenge that assumption, but my point is not to challenge it. I know from installing the stuff at 150 pounds minimum bond strength per square foot, it's not going to blow off all over the place. The ceiling would give away, the wall could be – all this. It would be much more destruction. The plane's impact didn't cause the structural failure. Obviously it withstood the plane so we had to have something else, obviously, the fire.

The thing that bothers me as an applicator, and I'm not a Ph.D. or anything like this, why did these things come straight down? What physical conditions can we use to explain it? That's a bother to me. And I'm going to suggest it's the fireproofing. Now, again, I went to the library. As my wife says, I better get a life. But in it, it makes a couple of references to a half-inch of fireproofing here or there, and I believe that was mentioned again this morning.

Well, as an applicator, that tells me a couple of things. One is, there had to be assumed to be a thermally restrained structure because the thinnest you can you get is 3/4 of a inch for an unrestrained structure. We know that that was a wrong assumption by the engineers, that was just dead wrong. It also tells me by several references that the beam size played no role in determining the thickness. It does. It's required. It has been required for the 25 years I've been in business. Of course, finally, there's been no thickness adjustment. There's been a half-inch everywhere, that's incorrect.

I happened to be at a presentation for a Dr. Corley and he had some photographs, and in the photograph, there's about 60 or 70 fireproofers out there, and we saw painted steel. Well, painted steel needs special treatment. You could see it as the bond break goes right down. We didn't see it. Dr. Corley, what's going on here? So, there's three things we know are wrong, and I'm as dumb as a rock, a fireproofer. Now, there may have been many other things. This happened all the time. Cold weather applications affect the bond. We heard about some of it falling and some of the – maintenance is a problem, scheduling problems. These occur all the time.

I have here, and this is available to anybody, about 40 pages of a detailed analysis. I went to the books, I measured the steel, I calculated the steel, and I found out what it should have been. I know in the FEMA report, item #115, which was a beam, in the unrestrained – or the restrained conditions, which I assumed it was, it was still 15% light. And in the unrestrained condition, it was 50% light. Item #120, which was a column, I calculated the thickness on that, that was 80% light. So now we're starting to get a picture here of what could have gone wrong. We also know some of the members are painted. We never see – saw any evidence in the photographs of this bond break that's required. And this has been required for a long – this is not new stuff. We all should know how to do it.

But the argument that I also have is these probably all passed the test somewhere along the line. This didn't happen yesterday. This has been there for 30 years. So it should have been

picked up by the inspectors on the site. It should have picked up on the inspections during the course of the 30 years. And it wasn't.

Now, the thing that bothers me most, and it breaks my heart what happened, it's going on today. Jobs up in Connecticut, jobs everywhere, it's going on right now, the same damn mistakes we had here, we're making them again. We're never going to learn. I don't know if you guys are all going to believe me or not. Whether you say, hey, this guy's a contractor. He hasn't got a Ph.D. or anything like that, but I'm offering you the opportunity, these are the calculations. I'll sit down and I'll defend my position with anybody. Tell me I'm a jerk, that's fine, go ahead. But this is right.

My final comment is, and I appreciate all of the work they've done. I've made a pest of myself down in NIST. And they invited me down and they treated me well, and I was all appreciative of it. But all the fine work all you guys have done, and there's all these really smart guys, unless it gets down to my level, I don't want to say it's worthless, but the value is greatly diminished. You know, we have to know how to install the stuff. We have to have inspections and stuff like that.

One quick, I don't know what time it is, but I don't believe it's proper for somebody to come up here and bitch and moan about things without offering solutions. And I think there're three areas we have to focus on. One is we have to eliminate the technical inconsistencies within our code systems, our U.L. Books and the ASTMs and stuff like that. One says one thing, another one says another thing, and contractors are great use to their advantage to get a cheaper faster application we'll use. So that has to kind of be straightened out.

The second thing is, and this has been mentioned before, we have to have a continuing enforcement procedure, not only at the time of application, but a continuing one, as well. There can't be any rubber-stamp guy who's under pressure because he's got the job. He'd better approve of it because this contractor says, if you don't approve it, I'm going to sue you. There's too much pressure. It has to be –

And finally, we have to create incentive. Right now there is no incentive to do it right. As a contractor, I always start out wanting to do every job right, but when I start getting screamed at and hollered at because of the schedule, because of the weather conditions – and we were fighting, we just had 10-degree weather, we were fighting like hell over that. So there's too much pressure and there's no incentive. They want it done fast and they want it done cheap and let's get out of here. And a lot of people have paid the price for that. Thank you very much.

Dr. Hill: Thank you Tim.

The next speaker is Colleen Delaney. And while Colleen – is Colleen here? Okay. Well, we had a miscommunication with one of our speakers, and he's not available this afternoon, so he asked to be able to speak this morning, so we'd like to introduce now Anthony Pugliese from New York City Carpenter's Union. Is Anthony here?

Okay. Well, we'll have to work him in after lunch then.

It is just about, just a hair past 12:15, so we're back on schedule. We'll break for 60 minutes. We'll return at 1:15 for a Q&A session, and then some additional comments from the public. Thank you.

Afternoon Session, February 12, 2004

Dr. Hill: We've had a number of people who've left for the day or people are going to be a little slow getting back from lunch, but I'd like to keep on schedule, and therefore I'd like to start the 1:15 session. This is a question-and-answer session. We've scheduled 30 minutes for it. We do not have to use the whole 30 minutes if we don't need it, but if we do, we certainly will. We will start at 1:45 or sooner with the speakers for the afternoon. The one individual that was not here right at the end of the morning is now here, so we will allow him to speak first, and then we'll start with the regular cast that we had planned for the afternoon.

At this time, I'll open the floor for questions. There are two microphones in the center. I would ask you to come to the microphone, identify yourself, and then ask the question of Shyam. And the idea is, if you have any questions about his presentation this morning, the status, the details of the investigation, you are free to ask. Yes?

Nico Houts (ph): Hello, my name is Nico Houts. I'm with (inaudible). com, the (inaudible) World Report. Also other (inaudible) related research and (inaudible) projects like NY911.org or (inaudible).org.

My question's referring –

Dr. Hill: For Dr. Sunder?

N. Houts: No, it's the Q&A. Yeah – addressed to the NIST. I would like to show a picture.

Dr. Hill: Now is this a question or a presentation?

N. Houts: Yeah, my question is that I would like to find out why the NIST is not looking into the collapse of WTC 7 compared with the other creation details. Because building 7 was the only building, when it looked like this in the morning, less than this, which was ever created immediately. We know it was a military and CIA-connected building. We would like to have a very simple explanation, in 5 seconds from the NIST, why this building collapsed at 5:25 p.m. while it was not hit by any plane or destroyed by any kerosene inside.

Dr. Hill: So the question is –

N. Houts: And there's three radios around which we can see on the internet, so this is clearly, there's clearly public records available that this building collapsed within 7.8 seconds in its own footprint. Here's the picture. I would like to have a simple explanation, of why (A) the major background of this building, including Black Stone, TOW, is not available, what they did in this building. (B) A simple explanation why this building collapsed within 7.8 seconds in its own footprints, and on the north side it's burned only in two floors. I'm not talking about the south side, but the north side.

Dr. Hill: Shyam, do you understand the question?

Dr. Sunder: I think I understand part of it.

Dr. Hill: Go ahead.

Dr. Sunder: I'll try to, I'm not sure I'll get it done in five seconds. But we do have information on the plans and design and structural system for WTC 7. We also have detailed information on the fuel tanks in the buildings. These buildings, because they contained various functions, at the bottom of the building was a Con-Ed substation, and there was emergency fuel tanks in the buildings to supply for various offices that were in the higher, upper floors. There was a trading office, and the trading office needed continuous power, as did emergency operations for the City of New York. And there were oil tanks, fuel tanks that were in the basement level, as well as the different levels in the building.

N. Houts: Wouldn't we call floors?

Dr. Sunder: Excuse me?

N. Houts: Wouldn't we call floors, (inaudible) the 8th floor? (inaudible)

Dr. Sunder: Yes.

N. Houts: But it was not the reason for the collapse. (inaudible) I would like to find out from NIST and from the 9/11 Commission (inaudible) are not discussed in public.

Dr. Sunder: They will be.

N. Houts: (inaudible) evacuated immediately.

Dr. Sunder: Thank you very much. We will fully report. We have begun reporting, and we will fully report on the fires in WTC 7, the causes of the collapse in WTC 7, as well as any other evidence from first-person accounts about 7. We do know, for example, that at some point in the morning, they'd given up fighting the fires in the building. And that was one thing we do know for sure. And at some point, another time in the day, maybe the power was shut off, as well. So, these are things that you will see.

N. Houts:9:59.

Dr. Sunder: Excuse me?

N. Houts: Power was shut off at 9:59.

Dr. Sunder: Right. So these are things that are in our reports, will be in our reports, and will be an integral part of our investigation. So stay tuned, we will get more information as time goes on.

Dr. Hill: Okay, additional questions. Yes? If you want to, you can line up behind the microphone. We'll just take you in order.

Jake Pauls: Dr. Sunder? My question relates to –

Dr. Hill: Could you identify yourself, please, sir?

J. Pauls: Yes, Jake Pauls, from Jake Pauls Consulting Service of Silver Spring, Maryland. Dr. Sunder, if my notes are correct, at the conclusion of your remarks this morning, you essentially said that at the end of this study the emphasis in terms of code recommendations will be on

performance-based, not prescriptive solutions. I don't quite understand that. I'd like to hear you expand on it a little bit, because in some cases, we have to recommend prescriptive solutions. For example, I think you would be shirking your responsibilities as a research agency to say, for example, that the width of the exit stairway should allow counter flow and to egress movement without interference. It's much easier to give a prescriptive requirement based on research findings in that situation. So could you expand on that somewhat?

Dr. Sunder: I said that because there might be an expectation that we will actually write or have recommendations that read like code language. We probably will not have recommendations that read like code language. They will, in fact, be recommendations for code bodies to consider, given the best technical knowledge they have today. And whether that deals with egress or with fire protection or the response of the building as a whole on fire rating systems, and so on. At this point, since we haven't formulated those recommendations, I would be speculating if I said what prescriptive and performance would imply. But the key issue is, we don't want to be regulatory in nature when we make those recommendations. We don't have a regulatory role. So that's where I'm trying to draw the distinction. That we need to be away from a regulatory position posture.

Dr. Hill: Okay, the lady in the back first.

Amanda Fortier (ph): Hi. My name is Amanda Fortier and I'm helping with an independent documentary on September 11th. And my question for you is, why – it's my understanding that – the doors on the top floors of Tower One were locked? So my question to you is, is this true? And if it is, why is that?

Dr. Sunder: This is something we're still in the process of studying. I'm not in a position yet to say the doors were locked or not. We certainly have accounts that we've heard, much as you have heard, that the doors may have been locked. We do know in 1993, at least, there are some examples of evacuation, helicopter evacuation, through the roof. We are trying to study what the policy changes were following 1993 with regard to roof evacuation. And we're also looking at the design of the doors. From what I understand, there may have been multiple doors that you had to access to get onto the roof. And those sorts of information we will make public, because that's a very important part of trying to understand why roof evacuation was not done.

Audience Member: (inaudible)

Dr. Sunder: Excuse me?

Dr. Hill: I'm sorry. Sir, if you want to ask a question, would you come to the microphone, please.

Audience Member: Well, I have a forwarded email from one of the family members, and they told me that they are looking into the case, if they were able to escape from the steel doors. They had information from a security company, I think on the 12th or 15th floor, where you had to use automation to open these doors. I never heard about this story before. I'm looking into this.

Dr. Sunder: We will certainly look into that issue.

Dr. Hill: Okay. There's a man here in front who had a question. Yes?

Audience Member: My name is Dr. Zia Razzaq. I'm a structural engineer professor at Old Dominion University. Dr: Shyam Sunder, you had mentioned that NIST has 236 pieces of steel, taken from the towers. Are you going to allow access to research professors and graduate students to inspect those?

Dr. Sunder: The short answer to that is, we haven't developed a policy yet as to what happens when the investigation is finished. There are going to be a number of factors that we need to consider in terms of disposition of the steel. Most important, one of the important factors of which, we will consult also with the families to see what they'd like to see happen with the steel. But we will consider those inputs before we make a decision.

Dr. Razzaq: Okay. Part B of my question. In particular, I'm interested in any other column cross-sections or segments, and also the core columns, as well as any angled sections that might have been used in the construction, like double angles, Ts and things. To your knowledge, do they have enough of those for, perhaps, possible destructive testing in the future?

Dr. Sunder: Yeah, sure. As I said, we will consider that completely. In the meanwhile, very shortly, in the next several months, there will a very detailed report that documents all of the steel we have, very specifically, piece by piece, in a very detailed fashion and with color photographs and things. So, you will at least know what we have, and then the next step would be getting access to it.

Dr. Razzaq: Great. Thank you.

Dr. Hill: Additional questions? Yes, back in the back. Okay, go ahead.

Paul Kirwin: Yes, my name is Paul Kirwin. My son was on the 105th floor of Tower One with Cantor Fitzgerald. I watched a television program this week on Channel 13 called Innovations. And they showed the skyscrapers being built in Taiwan and Shanghai. Evidently the building codes, or whatever the regulatory codes are there, they permit or recommend the use of elevators. And I know that in this country, particularly in New York, they don't have it, but I do see it on page 24 of this presentation, they're considering it. I think something should be done to investigate that aspect of evacuation. Because, according to the way the Asian people, including, I believe, it's a Mr. Robinson who handled some of the work here, they can evacuate a 78-story building in 20 minutes, whereas they said that on the World Trade Center towers as they existed, it would take you more than an hour to get the people down. So perhaps in this new construction they're profiting by our experiences, but I think something should be done to investigate or enquire about the possibility of using elevators. Evidently there's no real problem except, I guess, fireballs or whatever, but I think that should be an area that the committee or the institute should look into.

Dr. Sunder: We appreciate that. That is something we're going to take very seriously as you heard me say this morning, the use of elevators for emergency access of the firefighters, but also evacuation, particularly those that are disabled or handicapped in some way. Yes, very important.

Dr. Hill: Yes, sir.

Leonard Crisci: Good afternoon. My name is Leonard Crisci. My brother was Lt. John Crisci, FD from the Hazardous Material Unit. I lost him in the World Trade Center. I have many questions, I

hope I am not limited to one during the time. To what this gentleman said and what this young lady said, I'd like to address the both of them.

About the elevators, the elevators were flawed from the start, the construction of them, with the sheet rock going up, 110 stories of sheet rock. There wasn't any redundancy in the walls. It was 1½ inches. There's reports of people who escaped the elevators with a squeegee, getting out of the thing, and nail files, nail clippers.

But one of the things I'd like to address about the elevators, have you looked into the fact, as USA Today had reported, that upwards of 200 people died as a result of being trapped in elevators? Now, just prior to 9/11, the World Trade Center was in the process of retrofitting their elevators and putting on a lock that prevented the people trapped inside from opening it up. As a former New York City police officer, I evacuated many people in housing projects who were stuck in elevators, by putting their hands through, bending it out, getting up and flipping a little jiggle they had on the side. Now, supposedly the World Trade Center retrofitted these elevators with this device that prevented those elevator doors from opening up from the inside in the case of an emergency.

As far as the evacuation on the stairwells going down, the stairs were way too small and configured in such a way, as a result of the sky lobby, to meet and then come down straight inside. So that if you did have a catastrophe, and don't think for one minute that Bin Laden and his fellows who planned this did not realize that the vulnerable point in the Trade Center was the sky lobbies of over 20 feet, 40 feet of open space, with no built-in redundancy and steel structure. And they hit that. And when they hit it, they cut off all egress from the floors above the sky lobbies

And part of this was because the evacuation stairwells, only three, and although the Port Authority says that they had more than the building was supposed to have, two, they had one more, 50% more, they were still not built right. It's like giving you a string when you need a rope. But I gave you three strings, all right? And that's what they gave. They gave us three poorly built escape elevators that came to a conjunction over the sky lobby. And once the sky lobby was taken out by the plane, most of the people in Tower One, or all of the people in Tower One were trapped above the line. The firefighters that went in there couldn't go up there to get the people out, and the people above were left there to die for an hour and a half, up there, watching everyone else die around them. This main thing in this thing here is that that building was flawed from the minute it was put up. And later on, if you will, I'll give you my theory about why it was done that way. Can you answer several of those? Thank you.

Dr. Hill: Thank you for your comment.

Dr. Sunder: First of all, we appreciate your comments, and the things that you've said are certainly the kinds of issues we are talking about and trying to work. Specific things, you talked about, the redundancy of the wall, or the ability of the walls to take anything more than the fire rating. The walls were fire rated using sheet rock. And we are thinking about the idea of, if the shafts that hold elevators and stairwells are the last line of defense for evacuation, should those have structural integrity beyond the normal fire rating? And that is something we are looking at as we formulate our recommendations.

With regard to the elevators and the way in which elevators work within an emergency situation, such as what you've mentioned, we are working that as well. In fact, as I mentioned, Dick Bukowski has a workshop scheduled for early in March where he brings the entire elevator

industry and the standards organizations in that area to think about what are the issues associated with emergency uses of elevators. And so we will be developing findings and recommendations related to that.

Audience Member: (inaudible)

Dr. Sunder: Dick, do you want to add comment to this, specifically?

Dr. Hill: Dick, do you want to use the mike?

D. Bukowski: If I understand what you are talking about. I believe what you're talking about is a device that's been retrofit in elevators to prevent the doors from being opened from the inside unless the elevator is within a certain zone. It's considered a safety issue because if you can get the doors apart if you're outside of this zone, then you can get something chopped off, as the elevator comes up. So there's a restrictor plate that was being put on. And it's being put on elevators all over the place, just as a safety device. Yet, it would allow the doors to be opened from the inside, but only if the car is within a safe area of the normal landing.

L. Crisci: But what happened at the Trade Center? Many of those elevators did not reach that safe area. And many, many people, as I said, USA Today said over 200 people died in the elevators. Now, for the amount of fatalities a year in elevators due to that, due to that device, was it worth it? (inaudible) forced into using it and in the fact that it failed. It failed in the World Trade Center because, you know as well as I do, that there had to be one person who was in that elevator who couldn't get out because of that device, and that there had to be one person who was in that elevator who couldn't get out because of that device. And that's probably the same one person who opened it and fell out of sheer negligence. Thank you very much.

Dr. Hill: Okay. We have time for two more questions in this session. The gentleman in the front, first.

Audience Member: That's not fair. This doesn't work.

Dr. Hill: I'm sorry? Well we – okay. Is everyone in line back there to speak? Okay, We'll take everybody that's currently standing. You're first.

Les Jamison: Okay. Okay, just three quick points. The South Tower, as we all know, the plane hit at an angle, and the explosion went through the building, and the big fireball showed that the fuel, most of the fuel, exploded outside the building. And my question is, is NIST taking this into consideration in trying to explain that fire from the building materials, maybe within the building, burning for, say, 56 minutes, was enough to melt steel girders to cause the collapse as it did?

Dr. Hill: Can you tell us your name, sir?

L. Jamison: Oh, sorry, Les Jamison.

Dr. Sunder: Let me comment generally on this topic area. There are a number of issues you've raised. The South Tower the plane did hit at an angle, and since it hit at an angle, it was another factor beyond the fire proofing thickness variation that was alluded to this morning, that had a role, a potential role, in the earlier collapse of that building, because if you take out corner columns in a building, there's a tendency to want to tip over. It didn't tip.

The other aspect is, in both towers when the planes impact, there was a large fireball, or large fireballs in different sizes. What we are doing is measuring the size of those fireballs and calculating how much jet fuel was consumed in the fireball. Our initial estimates of whatever the jet fuel was left is that about 1/3, somewhere in that ballpark, it may be 20%, 40%, about 1/3 of the jet fuel was consumed outside the building in the fireballs. So all you had was the remainder to work inside the buildings to ignite the contents. So we are considering those factors as we do our modeling.

L. Jamison: Just one other quick – I recently saw a film by 9/11 Families for Peaceful Tomorrows, and in it was a clip of the North Tower falling. I believe it was filmed from across the river. Okay, it was that film. And just before you see the top start to cave, about 10, 15 stories below, you see what looks to be explosions, going straight out along the walls, right around uniformly. I'm just curious to know if this is something that also NIST is taking into consideration and providing an explanation for? Thank you.

Dr. Sunder: Yeah. Often times we have to be very careful when we use the word explosion. There are many things that can cause effects that seem like explosions. One of the things that can happen is when you have floors pancaking on each other. The air is suddenly squeezed, materials in there are sent out. So there's a bunch of things that come out, and that may seem like explosions.

Now, we do have a video which we actually went public with some time ago, we went public with it, which shows a line of smoke that suddenly traverses somewhere in the floor 90-something or the other on the North Tower, north face. And it moved very fast, and our initial thinking is, the only way a line of smoke can move that fast is if something drastic had happened in terms of an internal collapse, potentially a floor. But these are the kinds of issues, we hope to resolve as we go forward in terms of what they actually mean.

Dr. Hill: Yes sir, back here.

John Napolitano: Hello. My name is John Napolitano, I'm the father of Lieutenant John P. Napolitano from Rescue 2, the FDNY. I just wanted you to briefly look at his picture. He's one of our first soldiers of the 21st century. Now Lenny and I grew up together in Brooklyn. And like Lenny, I had some time as a cop. We got there on the morning of September 12 to search for my son, Lenny's brother, three of my son's childhood friends, Billy Mahoney from Rescue 4, Pete Brendan (ph) from Rescue 4, and Glen Pettit (ph) from the NYPD, and any other parents' children that may have been trapped, and we came home with no one.

In 1993, the World Trade Center was the subject of a terrorist attack. The Port Authority of New York and New Jersey and the City of New York knew that that structure and others would inevitably be the subject of another terrorist attack. If my son was a soldier and killed in battle, I would be just as hurt and devastated, and I would be angry. It's only natural. I would be even more angry if I knew that the government gave my son blanks for his rifle and didn't tell him. On the morning of September 11, 2001, many first responders were sent into battle on a suicide mission and were given blanks. And I hope that the people investigating this, show just a fraction of the courage that my son and the other heroes showed that day and let the chips fall where they may and hold people to task. Thank you.

Dr. Hill: Thank you. Thank you, yes, ma'am.

Caroline Martin: Can you hear? My name is Caroline Martin, Family Association of Tribeca East. My main concern is that they are rebuilding the Trade Center site. We are (inaudible) coverage from the Fire department. We were told that the fire department had signed off on the rebuilding. However, looking at the EIS, we see that, in fact, the fire department wrote to LMDC and said we're not planning any increase in stock. We haven't seen your plans. We really have nothing to tell you. So, can you put – will you end up with something which recommends how much fire department coverage all of these new, huge buildings and vast numbers of tourists will need so that the fire department can get the money and have the people that are needed so that we don't have another one of these disasters?

Dr. Sunder: Well, there are probably two or three aspects of your general question. And we have a role in one part, which is making technical recommendations. There are other people with important responsibilities in making sure our buildings are safe for events that should be considered as part of the life of the building. Those are the regulatory authorities and the private sector model code organizations. And my hope is, from what we've heard this morning from the model code organizations and the local regulatory authorities, there's a willingness to understand what the key findings from these kinds of studies are, and investigations are, to improve safety. So we hope that will happen collectively.

Now, I think I should mention a little bit about this notion of terrorist attacks and how there are multiple levels of responsibility that go in this, all the way from keeping planes or terrorists away from our buildings, this whole aspect of work. There's also the aspect of what's a cost effective way of dealing with a terrorist situation when they happen, within the context of a city, or in the context of a building complex. And what are ways – antiaircraft guns as opposed to, necessarily beefing up the building itself. There are different solutions and I think those kinds of issues are based on risk assessment for specific facilities.

There are lots of facilities that may not have that kind of risk. So, to apply the same requirements for all buildings may not be appropriate. And so, among our recommendations would be the consideration of appropriate risk consistent recommendations for preventing attacks, and insuring safety. So that's a long-winded answer to your question, but it's a complex issue.

Dr. Hill: Okay. Next, sir?

Joe Hehir: My name is Joe Hehir, I'm a retired Chief, New York Fire Department. After the events of 9/11 there were something like 500 interviews taken by the Fire Department of the first responders. These are trained responders. They traveled across the Brooklyn Bridge, responding – the towers were in their full view. They traveled down Manhattan. Did NIST get any of these interviews? These were people that were eyewitnesses initially to this event. Did NIST get any of these interviews or does NIST have them?

Dr. Sunder: Yeah. The short answer to the question is yes. In fact, we have begun to review those interview reports, but those are only one – and they are very valuable in understanding the perspective from that time. We are also complementing that information with first-person interviews that we're conducting of fire department and police department staff, current and retired. And we're spending close to three to four hours per each individual to get information. So we're getting additional information from our own interviews. And thirdly, we are also reviewing the 911 tapes. I've spent some time hearing some of the 911 tapes and there is really very good firsthand information of real live information, not secondhand, through other people

who did the job. But we have some firsthand information of the scenarios and scene as it was unfolding that day. So I think all of this will help us better understand what went on.

J. Hehir: You got those 500 interviews?

Dr. Sunder: Yes.

J. Hehir: Those debriefings that the city of New York did, all 500?

Dr. Sunder: Yes, we have access to all 500 of them in several boxes, and we're going to be reviewing them over the next month.

J. Hehir: Thank you.

Dr. Hill: Yes, ma'am?

Diane Dreyfus: Hi. Diane Dreyfus, 9-1-1 Health Alert. I have one question and one comment. My question is, we've heard that it was common practice in the '70s to put detonating material throughout the floors of a high-rise so that in the event it needed to be demolished in a very dense area, they could come straight down. We've heard that that's what's in the World Trade Center. Nobody said it here. Could you just for the sake of the record say, were there any detonating charges in the World Trade Center, to your knowledge?

Dr. Sunder: At this point, to the best of my knowledge, I have no knowledge about any detonating materials in the building.

D. Dreyfus: But you do know that that was something that was done at the time, right, that that was a style of building?

Dr. Sunder: I'm not aware of that. Maybe – are any of my colleagues, aware of anything of that? No. I would say that there are well-established companies that do controlled demolition of buildings, and they go in when a building has to be demolished. And you've seen pictures on TV and so forth, but I haven't heard of this.

D. Dreyfus: Sure. Yes. Let me ask you about this. What happens to insurance and occupancy in buildings that cannot be retrofitted and comply with your new standard?

Dr. Sunder: Now that's a very, very complicated question.

D. Dreyfus: Thank you.

Dr. Sunder: As you all know. And I don't have the answer. We can talk about it, but -

D. Dreyfus: But in essence, what we're saying here is that all of these methods, when they're implemented, will obsolete most of the building stock throughout the country, and perhaps the world. What happens? How can you push this kind of legislation through with that kind of resistance?

Dr. Sunder: That world where the decisions are made with regard to retrofitting buildings is actually done by state and local jurisdictions who adopt those regulations, and so the arena where that discussion takes place is with the state and local authorities. And clearly we can

suggest, you know, if we think that there are certain safety issues that people need to consider in existing buildings, we'll make that recommendation, but that's a recommendation we make.

D. Dreyfus: Thank you.

Dr. Hill: Yes, ma'am.

Elizabeth Madsen: Good afternoon. My name is Elizabeth Madsen. My husband Bob was in Tower Two on the – his office was on 96. He was at Fiduciary Trust Company. I just wonder – I know that both towers had considerable financial institutions in them. All of those financial institutions had safes, and those safes had to be reinforced for many floors below them with extra concrete. Do they have anything if one of those let loose, did they – did that have anything to do with some of those towers, either one of them, collapsing? I've not read anything about that.

Dr. Sunder: Thank you for your question. As we are building our models, we are reviewing the actual modifications that were made to the buildings after they were initially designed. And we have come up with three or four significant modifications, one of which was when Fuji Bank wanted to install a safe. I believe it was in Tower Two. I may be wrong, but it was high up in the building, and was supposed to be a 10,000 pound safe. And they did strengthen columns that supported the safe, and the strengthening went for 30 or 40 stories below where the safe was to be kept. So I do know that there was reinforcement done for that one example.

E. Madsen: If that 10,000 pound vault let go, could that have pulled the towers with them, or helped to?

Dr. Sunder: My sense is, probably a 10,000 – remember, there were 200,000 tons of steel in the building.

E. Madsen: Yes.

Dr Sunder: So the 10,000 pounds is important when it comes to a single floor, but when it comes to a collection of floors, 10, 20, 30 floors, 10,000 becomes a small fraction of the total load. But it is something that is part of our model, and we will include it as we analyze the collapse.

E. Madsen: Thank you.

Dr. Hill: Okay, thank you all for your questions. Let me review what's going to take place for the rest of the afternoon.

Dr. Sunder: Jim, I think there's one more question.

Dr. Hill: Oh, I'm sorry. I didn't – Yes, sir. Identify yourself, please.

Neil Winberry: My name is Neil Winberry, retired Captain, New York City Fire Department. I had 27 years in the job. I was an aide to the deputy chief in this division prior to the construction of the World Trade Center. And when we saw that the change that they made in the building code, it was an unbelievable move. In 1945, at about 9:00 in the morning on June 28, an airplane flew into the Empire State Building. It hit the building between the 78th and 79th floor. It was a B-25 bomber that we used bombing Tokyo. 14 people died, 25 were killed. The fire department was

able to put the fire out with a third alarm assignment, because of the construction under the building code in those days. The new building code came in. They reduced the amount of protection. In those days, there was a four-hour protection on steel beams with reinforced concrete. They had to have rebar in it. And the concrete was – they told you what type of sand, what type of cement, what type of gravel, and how much water was allowed to be used in the mixing of that concrete. Now they come up and they put steel beams in. These beams were manufactured, I hope, in the U.S. but however, they were laying out in the field. They become rusted. They came in, and they put them up, and they come out with a spray. I called it a slurry. It was some kind of a mixture with asbestos in it. They were supposed to spray 2 inches on it. Now that, they said it gave it a two-hour protection. That's down from the four hours that was required under the old code. But then this here stuff was put up. These beams laid here on this site and they rusted. They were transported on trucks; they rusted. They were transported on trains; they rusted. The rust, the spray was put on over the rust. When the explosion occurred, the fire protection went out in a dust cloud, and there are many people who are going to pay the price for that.

I had one fireman I met after everything calmed down here. And I asked him if he got any of this dust, if he had breathed it in. He said, yes. I told him go immediately to your doctor and get an examination. I met him a few weeks later, he tells me, I'm on light duty. I've got a lung infection from the dust. That was within a couple of weeks they had it.

Now, as an aid to the Deputy Chief of Department, he had fire prevention in this district. We took in from river-to-river, 14th Street to the end of the island. The blueprints came up into our office. And all the battalion chiefs and the deputies all had to get a look at it. It's coming into our division. My boss was very involved because he has fire prevention for this area. And one chief commented. He says, it looks like two cheese boxes sitting on end. And I said, I think it's a revenge for Nagasaki and Hiroshima, because that's what they told us, they had Japanese architects design it.

Now all of this, I spoke to construction workers, operating engineers, foremen from the carpenter's union. They were the ones that applied the spray on the beams. They say, we got a lot of them, but some we didn't get. Now they come in here; they use sheet rock. Sheet rock is just gypsum covered with paper. It has no strength, no protection. They put it in with screws. In a fire, the screws heat up. The hole that the screw is in now deteriorates from the heat, and what happens to your sheet rock? It falls. There was – tons of water comes down inside that building. They have interior power – interior tanks for the sprinkler system and the standpipe and for drinking. They have intermediate tanks on different floors throughout the building. All high-rises are built this way. When these things broke, they broke with tons of water, 30,000, maybe more; gallons come pouring out of these tanks. And if there're pumps in the cellar and they're operating, they're pumping water through broken pipes.

The whole fire fighting system was destroyed. The elevators were destroyed. Everything in this building, it was a hollow core building; a hollow core. They put the elevators in it. They run every type of communications, telephone, radio, elevators are in it, it's a return for the air conditioning systems in the building, they're climate controlled. So they use this hollow core. These steel beams are put together, and like the house of cards, I call it. You take one card out they go. I had an engineer, two engineers on television, said this building was built to implode. Well, I've been in this here city for 79 years, and I don't know of – implode, in case of an earthquake. And I've been here 79 years and I haven't seen a teacup get broke in this city yet from an earthquake. We had one little rumble there, I don't know how many years ago.

Dr. Hill: Sir, could we possibly speak to you afterwards? You have a lot of information that we'd like to have. Could we have some of your time after the meeting today?

N. Winberry: Well, I could sit down and talk with any guy. I'd be glad to, man. I've been talking about this since it happened.

Dr. Hill: Please.

N. Winberry: But I'll tell you one thing that you got to remember. One thing you should know. An order came down from headquarters, fire headquarters. The local fire companies will not inspect the construction site. It will be taken care of at headquarters. And I had a very good question for the boss. I said, who got paid off? When I saw what they were putting, this spray they were going to put on, I think it was NYU, check me out, I could be off on this. But I understand that NYU got a grant to rewrite the building code prior to construction of this place. The only ones that had input into it were the construction companies and the real estate interests. They didn't consult with the fire department, we had nothing to say about it at my level, I know that.

Dr. Hill: Okay. We would like to get additional information if we could. Could we see you at the break this afternoon?

N. Winberry: Well, I could find out a lot more, if you want. You know, we can sit down, I'll talk forever on it.

Dr. Hill: Okay. We'd be happy to talk to you.

N. Winberry: Well, I just want to bring this to the attention. As far as the radio is concerned, back in the '50s, we had the – walkie-talkies, a big box hanging on your side, and a telephone. They were horrible. They fell apart. You'd take the phone off, the bottom dropped out of it. Motorola. Then they come out with the handy talkies. Well, they're not too bad, but in this area and in other sections of the cities with the high-rise buildings, it's difficult. They didn't work in the subways, and they were almost line of site. Motorola.

Dr. Hill: Okay. Again, thank you for your comment.

N. Winberry: I thank you.

Dr. Hill: Okay, I'd like to review a little bit the schedule for the rest of the afternoon. We're going to go back now to the formal presentations that people had signed up to previously. We had one speaker who we couldn't get in at the end of this morning, so Monica, we're going to make you second, if that's okay.

And we'd like to hear at this point from Anthony Pugliese, representing the New York City Carpenter's Union. Up at the podium, Anthony, please.

Anthony Pugliese: Good afternoon. It's an honor to be here to speak in front of some brave people here in this room. Sometimes when you get to sit and wait, you get to listen to a lot of people and what they say. And you realize that we as people of the 21st century have a lot to be held to when you get to hear things that are true. And you had the opportunity to correct the problem in the past and not make it happen, shame on you. When it happens twice, shame on me.

So, my name is Anthony Pugliese. I am an organizer for the New York City District Council of Carpenters since 1998. I've been a member of the Carpenter's Union for the past 30 years, which also lost 16 members on September 11, 2001. I've worked on high-rise cast in place, reinforced concrete construction for over 10 years, from 8 stories to over 30 stories in height. No one will ever forget September 11, 2001. That day, I was running for political office in Brooklyn, and was in Cal Gardens (ph), my own neighborhood, shaking hands with people and friends that went to work at the WTC, promising to vote. That night, as we all know, not everyone came home. People have asked, why did the World Trade Center collapse, how did it collapse? How can we prevent this from happening again? All very important questions to ask. Who has the answers? I cannot tell this audience that I am an engineer or have a degree in physics, but I do know what I have built and worked on in this great city of ours.

Question 1. Let's look at why the World Trade Center collapsed. The terrorists looked at the plans of the World Trade Center and saw that the steel was only protected by a sprayed on substance, which we call Monokote, which was not actually applied by carpenters. Some think that high heat or water or the explosion of a flying missile could bring down the integrity of this product. Because that was what this plane was designed to be, a flying missile.

How did it collapse? I'm sure many people saw on TV, the special design and flaws of the World Trade Center, where the experts showed that the bolts that held the steel girders, that held the floors together to the center of the building's core, caused the outside panels to fall outward and for gravity to take over and pancake the buildings downward. This is important because both buildings acted in the same way.

Question 3, how do we prevent this? Who'll be the first to say that money should be the determining factor in how we built in our city or how to build high rises? And it's not to say that cast in place, reinforced concrete is higher in price. But what would prevent this from happening? Would making the building as strong as its foundation, the World Trade Center foundation, which is cast in place, reinforced concrete, withstood all the weight of the collapsed building's steel that fell on it? Cast in place, reinforced concrete is protected by concrete, solid and lasting, plain and simple. All the floors and columns are interwoven through steel rods placed and laced throughout the floors and the columns.

Many years ago, as that gentleman alluded to, buildings were protected, the steel was protected, by covering the steel in concrete, it was called goulash. A lot of the old buildings – the Empire State Building was a goulash job. But reinforced concrete communicates with itself from the foundation to the top of the building. The core of the 7 World Trade Center is concrete from the outside. It's called sacrificial steel, so this will collapse on the outside. Cast in place, reinforced concrete is not one floor on top of each other supporting the floor above it, but one solid building supporting itself from the bottom to the top. Cast in place, reinforced concrete is rescue worker friendly, and can withstand up to 30,000 pounds per square inch.

I would like to add that in 1993, when the terrorists tried to bring down the World Trade Center, they murdered people, they caused damage, and they put a hole in the World Trade Center. That's all they did. I'm 50 years old. I was raised to respect the men in blue, and the men who road in red trucks my whole life. And I think that we owe it to those people that protect our children, to work in our city, to work in our buildings, to give them the best product available. Build out buildings, build them with the best measures so this is never again done, only to show the children in the future on what was done and what we decided to change, and not ever let this happen again. And I thank you all for this opportunity.

Dr. Hill: Thank you, Anthony.

Next will be Monica Gabrielle. Monica.

Monica Gabrielle: Before you start the clock, I'd like to thank our friends at NIST for holding this open meeting. And I thank the families for coming today. I know how hard it is for you to listen to some of this information.

My name is Monica Gabrielle. I lost my husband, Rich, in the South Tower on 9/11. Although on the 78th floor at the time of the impact, he survived and was almost certainly alive when fire fighters reached the 78th floor shortly before the collapse of the South Tower. It is now nearly 18 months since the National Institute of Standards and Technology began its investigation into the causes of the collapse of the Twin Towers and the subsequent deaths of more than 2700 people. NIST's reports and conclusions are due in about eight months. As such, it seems a reasonable time to take some stock. Throughout the last 18 months, NIST has adopted the mantra of their investigation is one of faultfinding – fact-finding, not faultfinding. The central fact that the legislation establishing their investigation makes no such distinction, includes no such terminology, has been eclipsed by simple repetition. If fault is uncovered, so be it, but please do not tiptoe around the facts to avoid letting the chips fall where they may.

Many of us, and perhaps some in NIST too, came to the conclusion months ago that the basic facts pertaining to the collapse of the Twin Towers meant that faults were an integral, inseparable part of the facts. Perhaps it is because the facts are so stark, so incriminating, so alarming, that NIST's most senior officials seem reluctant to state them in the sort of bold terms they deserve. Worse still, these senior officials seem even more reluctant to address the questions that logically derive from such facts.

Such reluctance serves no one. If the basic gain is to improve building safety, as NIST maintains, asking questions, hard, difficult, sometimes embarrassing questions, is the only way to proceed. Throughout this investigation, there has been a marked reluctance to place the design, construction, and maintenance of the Twin Towers in context; the context of accepted practice and prevailing procedures. There has been a marked reluctance, and that now well-used phrase, to connect the dots, to ask why and how something happened, to ask how all elements of design construction and safety during the tragedy of 9/11. There has also been a marked reluctance on the part of NIST to issue emergency advisories on such basic issues as deficiencies in spray on fireproofing. So let me, a mere housewife from Connecticut, help out. I am going to state just some of what we know to be fact, and then ask the obvious questions any true investigators would follow through with. I thank Dr. Sunder for articulating progress on some of these in his opening remarks.

Fact 1. Despite the Port Authority of New York and New Jersey's mandate to its architects and structural engineers to use, in NIST's phrase, acceptable engineering practices in the design and construction of the Twin Towers, the Port Authority accepted, approved, and then they advocated totally unorthodox design features in the Twin Towers. These buildings were anything but accepted practice. Indeed, the Twin Towers combined so many unorthodox, untested design features, they may justifiably termed experimental: Bar joist floors spanning up to 60 feet instead of traditional steel beams; plasterboard enclosures of elevators and stairwells in the core instead of concrete and masonry; fireproofing for which the testing had not been completed. None of this was, nor is it today, accepted engineering practice, especially for buildings of such dimension.

Question: How can the Port Authority and how does NIST square the instruction to use acceptable engineering practices with those actually used in the design, construction, and maintenance of the Twin Towers?

Fact 2. The impact of large passenger aircraft flying into the towers at high speed had been considered. However, the possible effects of the inevitable multi-floor fires that would result from such an impact, the effect on the structural integrity of such a design of the Twin Towers, the potential for progressive collapse in such an instance, was simply ignored. This incredible oversight took place not once, but apparently twice, in two separate aircraft impact studies in '64 and '67.

Question: Was this oversight deliberate? It hardly seems possible that architects and structural engineers as experienced as Yamasaki and Skilling would overlook such a basic consequence of impact by aircraft. Yet these studies were both completed with the sole purpose of reassuring the public that the buildings were safe, that they could be safely built, that they could survive such an impact without collapsing into lower Manhattan. If fire, and thus the possibility of collapse had been considered, the Twin Towers could not have been built.

Fact 3. No fire tests were done on the bar joist floors that were such an integral part of the Twin Tower's stability. With no comparable floor assembly designs having ever been used in high-rise structures, and thus no relevant, comparable test listed, neither the Port Authority, the architects, nor the structural engineers could really know the fire resistance capacity of the bar joist floors in Twin Towers. Thus, the Port Authority's claim that the Twin Towers conformed to code is completely bogus. The idea that they met and exceeded, as their press officers claim to this day, is palpable nonsense.

Question: Why were no fire tests done on models or mockups of the floor assembly for the Twin Towers? It is hard to overemphasize the importance of such a basic omission. One fire protection engineer described it to me in Catholic terms. It was, he said, a mortal sin. Yet, the Port Authority was one of the few agencies in the country at the time with specialist fire projection engineers on its staff. Who was responsible for this abject failure?

Fact 4. A fire test done by the manufacturer of Monokote spray on fireproofing on the bar joist floor assembly modeled on the shop drawings of those for the Twin Towers demonstrated that 1.5 inches of fireproofing was required to secure a three-hour rating required by New York City codes. Yet in October 1969, the Port Authority instructed its contractor to apply just half an inch of a different fireproofing, Cafco Blaze Shield D.

Question: What was the origin of and the reason for the Monokote fire test, and what was its relationship to the absence of a Port Authority floor assembly fire test with the Cafco product they used? Did the Port Authority use the Monokote test as an excuse for not doing its own fire test? Worse, did they take the results of the Monokote test, then on the basis of calculation based on the differences in thermal conductivity of the two fireproofing materials, lessen the thickness to be applied by his contractor by two-thirds? In other words, did the Port Authority order the application of one-half an inch of fireproofing insulation, instead of 1-1/2 inches on the basis of a floor calculation derived from a test it had never performed? NIST knows all the basic facts here. Why is it not asking these obvious questions? Why has it not interviewed individuals who know about this?

Fact 5. The fireproofing in the Twin Towers was inadequate in both thickness and application. Even the Port Authority effectively admitted this, albeit a quarter of a century late, when a

fireproofing rehabilitation program was initiated under Frank Lombardi, the Chief Engineer in 1995. However, in the six years between '95 and 2001, the fireproofing in a mere 15% of the floor space in the Twin Towers had been rehabilitated. Even a legal settlement against the manufacturers of the fireproofing, U.S. Mineral, an award of more than $40 million in 1998, did not get the fireproofing rehab program out of first gear.

Question. Why was such a crucial building safety issue as the inadequacy of fireproofing and the floor assemblies ignored for so long? When it was recognized as a problem, why was the rehab program so slow in pace? Did the fact that on 9/11 most all the floors most affected by fire in the North Tower which had been rehabbed since 1995, contribute to the fact that the North Tower stood for almost double the time that the South Tower stood?

Fact 6.

Dr. Hill: Monica, could you wrap up, please?

M. Gabrielle: Okay. There was no complete evacuation plan for the Twin Towers because it had always been assumed that there was no circumstance in which mass, simultaneous evacuation of all occupants would be necessary. Such logic was downright irrational. In both February '75, in the nighttime arson attack, and again in February '93 with a truck bomb in the underground parking facility, relatively localized incidents in the Twin Towers, it necessitated complete evacuation. If you listen to the Port Authority tapes or talk to security personnel in the Twin Towers on 9/11, it is impossible to conclude that the failure to foresee circumstances in which complete evacuation became necessary, and the consequent failure to have an evacuation procedure at the ready, led to the hesitation and confusion as to what to do. In short, the absence of a massive evacuation plan cost lives.

Question. Why was there absolutely no change in emergency procedures to include the possibilities of mass, simultaneous evacuation after '75, then again after '93? I could go on and on.

A law enforcement friend of mine used to have an observation on internal police investigations. They ran on a simple principle. If you knew the answer was going to be embarrassing to the force, make sure you didn't ask the question. I must tell you, I have no hesitation about asking embarrassing questions. I, and many others, have since 9/11 built our lives around asking embarrassing questions. Unfortunately, my husband, Rich, is not here because neither he nor I asked the embarrassing questions before 9/11, questions about fireproofing, design, evacuation, exits. Questions about the competence or negligence of those we assumed knew what they were doing, those we thought we could trust. I'm not going to make that mistake again. And not just for my late husband's sake, but for the sake of the many others whose lives might be in the same danger today. Thank you.

Dr. Hill: Next is John McCormick from the Society of Fire Protection Engineers.

John McCormick: Thank you. The Society of Fire Protection Engineers appreciates the opportunity to respond to the NIST request for comments on the status of the current investigation of the collapse of the World Trade Center structures. SFPE members represent the collective national expertise in the field of fire protection engineering, and selected members of the SFPE were major contributors in the fire-related issues in the preparation of the FEMA-sponsored preliminary investigative reports.

SFPE supports the NIST investigation, but considers it only a first step. We urge that the results of the investigation be used as input to a roadmap for a comprehensive research and development program to enhance the fire safety design of structures. This program should incorporate all aspects of fire safety design as identified in the investigation, including structural fire safety design. We believe that the federal government should play an important role in developing the underpinning knowledge in this area. For example, there's a need for best practice guidance, which will lead to national consensus standards. Increased reliance on technically based engineering standards will lead to better buildings.

Further, we believe that NIST should explore professional practice issues that relate to increasing the contribution of both the fire protection engineer and the structural engineer and structural fire safety design. With better integration of fire protection engineering into the design of structures, the entire design team will be better equipped to address fire as a technical design consideration rather than as a regulatory constraint. With our collective knowledge of building fire safety performance, the Society of Fire Protection Engineers is prepared to support this activity in any way that we can serve. We look forward to participating in the dissemination of this information to our members. Thank you.

Dr. Hill: Thank you, John.

David Harris from the National Institute of Building Sciences.

David Harris: Good afternoon. I'd like to thank NIST for the opportunity to make comments on this important topic. I'd also like to take this opportunity, even though it's 29 months and one day after 9/11, to express my sincere sympathy to the victims, their families and friends in this terrible tragedy.

The National Institute of Building Sciences was authorized by the Congress as a nongovernmental, private organization in 1974 to deal with building-related regulatory technology and information issues. To the U.S. and the international building community, research assessments related to the collapse of the World Trade Center towers have many purposes and a lot of potential value. But to serve the broad public interest, such research can provide very useful findings about the performance of health and safety related building systems intended to protect the occupants from hazards traditionally addressed by building codes. These hazards include building fires, earthquakes, windstorms, windstorms from normal winds such that we experience at street level, which is much greater at the top of the World Trade Center, and, of course, severe winds, unusual winds, such as hurricanes.

My comments today will focus exclusively on the broad public interest use of these findings, although many other purposes are addressed by many other bodies. Specifically, I'll comment on several research initiatives by NIST that have grown out of the World Trade Center collapse and outline their potential for improving building performance throughout the U.S. and the world.

NIST research is the primary U.S. effort to scientifically exam the ways life safety related building systems and the facilities at and near the World Trade Center site performed. The National Institute of Building Sciences has strong interest in NIST studies to assess to performance of the building systems, specifically so the results can be, were appropriate, incorporated into building criteria such as building codes, standards, guide specifications, and the like that are used nationally and internationally to design and construct buildings. First and foremost, it is paramount that such research be scientifically based. Obviously, if the intent is to develop new ways to improve life safety in buildings, it is essential that these solutions be

effective. And where such changes add to the cost of buildings, we have an obligation to ensure that they are cost-effective.

Some of the – I'd like to comment on about three or four of the NIST programs. One is, addresses progressive collapse, an obvious response to the 9/11 disaster. To a large extent, existing building codes do address progressive collapse, but they address it from a standpoint of the probable hazard such as wind and earthquake and fire that have more traditionally happened in our buildings, certainly not from the forces to which the World Trade Center towers were subjected. This is not the first time that this kind of a hazard has occurred. The Murrah building that partially collapsed as a result of the truck bomb in Oklahoma City started some thoughts within the building process on addressing progressive collapse.

As a result of NIST's efforts, the progressive structural collapse issue was first addressed in a high-level workshop in Chicago July of 2002. That event resulted in NIST pursuing the development of best practice guidelines for mitigation of progressive collapse for the design of new and the retrofit of existing buildings. A draft guideline on this topic is now about 90% complete. The development process for this guideline includes review and comment by nationally recognized engineers, architects, code officials, researchers, and other government experts to insure that input is received from the nation's best experts from all applicable disciplines. To NIST's credit, this document will be a better tool because it is, and will be, subjected to open scrutiny.

Fundamental concepts and approaches in this guideline are likely to include redundancy for providing alternative load paths if primary load paths fail; ties, which help redistribute loads during catastrophic events; ductility, to help resist structural load failure during deformation; increased sheer loading capacity; and capacity for resisting load reversal. The guideline can be used as a basis for developing or revising standards, for structural loading, developing code change proposals, adding content for guide specifications, developing modules and structural design software, documenting of the costs associated with more robust structural design, and improving and changing training education curriculum.

Similar concerns to those related to structural collapse exist about fire conflagration events such as those the towers experienced. NIST plans for development of guidelines addressing the impact of fire on buildings can address such issues as smoke evacuation from floors above the fire in high-rise buildings, or increased pressurization of such floors to prevent the upward migration of smoke that would harm occupants on those floors before they can be evacuated. Other related efforts by NIST, I understand, include plans to study, and where warranted, recommend changes in fire protective materials used to protect structural members and connections from fire loading. These include assessment of, and possible development of, new performance based methods and materials with which to evaluate the fire protection materials.

The process is also an important issue to study. If the inspection sequence for structural fireproofing inspection and follow on installation by other trades, does this practice result in post inspection damage of critical fireproofing? Some of the investigation that they are conducting of the World Trade Center may shed light on this, in that specific building. Another issue is the use of elevators. We've all seen the placards in elevators, directing occupants not to use the elevators during emergencies. Certainly there are fail-safe systems installed in buildings and those systems that are manually applied by first responders to render elevators inoperable during emergency. The obvious reason for this is, in fire emergency, the heat from a fire can fuse the call buttons on lobbies, thus calling elevator cars and their occupants, to the fire location, obviously a terribly hazardous circumstance. Nonetheless, persons with disabilities,

indeed everyone in tall buildings, and fire personnel can make very beneficial use of elevators during emergencies if it were safe to do so.

Dr. Hill: Dave, could you wrap it up, please?

D. Harris: Yes. With new elevator control technologies, insulations in doors and shaft ceiling, many believe this is possible.

Although it doesn't directly involve brick and mortar building components such as structural frames, elevators, and fire protection an initiative, with perhaps the greatest potential to improve the performance of emergency and other systems in buildings, is a multifaceted series of programs to which, I believe, NIST has a great potential to make much needed progress. This is generally known as interoperability. This involves the development of a building model that will be the basis for organizing and structuring data about buildings, not just for the design of buildings, but for their operation and maintenance, that will allow models to be developed that will allow us to virtually pursue four-dimensional models of buildings to determine how they will likely perform in the event of emergencies and in normal operations. For example, through this concept, data about a building's design, materials, and operation would be entered into this four-dimensional model to depict how the fire loading would occur, how other automated assessments could predict structural and energy performance.

Dr. Hill: Dave.

D. Harris: Okay, one other thing. These and a number of other programs at NIST are uniquely focused on important building-related issues, and given the budgetary constraints under which NIST and other agencies must operate, their programs are appropriately planned and effectively communicated to the private sector. Following the 9/11 disaster, NIST quickly developed and has effectively pursued a substantive research effort that has excellent potential to significantly improve the safety of the nation's buildings. Thank you.

Dr. Hill: Thank you, Dave.

Donald Bliss, National Association of State Fire Marshals.

Donald Bliss: Thank you, Mr. Chairman. Good afternoon. My name is Donald Bliss. I have been a firefighter for the past 33 years, completing my career last November as the New Hampshire State Fire Marshal, President of the National Association of State Fire Marshals, and a Chairman of the NFPA Uniform Fire Code Technical Committee. I currently serve as the Director of the Center for Infrastructure Expertise, a not for profit, applied research group that is funded by NIST and the U.S. Department of Commerce.

I'm here today on behalf of the Partnership for Safer Buildings, which consists of experts from the fire service, insurance, and standards development communities, and the construction industry. As we have previously testified, the partnership has come to many of the same conclusions that you now seem to be reaching. We welcome your work, and we appreciate the time and attention that you are giving to fire safety.

You have requested comments that relate, and I quote, "to specific improvements to building and fire practice, standards and codes, and their timely adoption." An honest and objective assessment of the model building and fire codes would reveal that the codes are a series of compromises where safety is balanced against economic realities. One cannot blame the

manufacturers of products who use this process to create and defend markets. One cannot blame industry when fire chiefs, fire marshals, and other public safety authorities and advocates do not participate on the technical committees that write these standards. One cannot blame industry when the model codes are adopted without close scrutiny by government agencies, and one certainly cannot blame industry when the codes are not adopted at all, or are not enforced.

The American fire service, due to a multitude of influences, is largely in the business of suppressing fires and not preventing them. I personally think that such priorities have been misdirected, but that is the reality. In spite of the realities, one cannot portray the model codes as anything more than what they are. They represent the sometimes arbitrarily established minimum acceptable levels of safety often as defined by the people who construct, own, manage, and maintain buildings. Those who care to provide higher levels of safety, either amend the model codes, such as how the state of New Jersey has done, or meet higher levels of safety voluntarily.

The Partnership for Safer Buildings and the National Association of State Fire Marshals are attempting to persuade the two model code organizations to reconsider their decision to significantly weaken the building code provisions concerning fire protection requirements in commercial, educational, multifamily residential, and institutional facilities. These are issues that you are looking at. Hospitals, schools, office buildings, and multiunit housing now are being built without protection that was required just a few years ago. We have asked why.

According to the management of the International Code Council, the values given in the height and area tables were determined by merging the three existing building codes. This has been described as a necessary compromise in order to combine organizations and establish a single national code. Perhaps, but we question why the least restricted elements were chosen as a result? Where is the data to support this? The National Fire Protection Association's new building code has established similar requirements. The Partnership has also raised the question of why there are no requirements in the model fire prevention codes for re-inspection and repair of certain passive fire protection measures, in spite of significant evidence that the cheapest of these materials deteriorate sometime soon after occupancy.

We have filed specific documented proposals to both model organizations, but let me share the results of a straw poll taken by one technical committee. We had several proposals on the table, but the most critical was rejected by a vote of 12 to 8. Favoring the proposal were experts from Underwriters Laboratories, Factory Mutual, and the State of California. Opposing the proposal were 5 consultants with undisclosed clients, the sprinkler industry, and the United States General Services Administration, which has consistently fought for lower construction costs. The remainder of the for and against votes were cast by people selling various products. But not one fire code official is on the committee, a situation that we hope to resolve in the near future. This matter soon moves to a formal committee vote where a 2/3 majority is needed, and then into a review and comment process that will consume at least another year.

Is the code development process fair? Most certainly. Is it science based? In most cases it is not. Is that in the public interest? That may be the question you and we need most to examine. Let us accept the model codes for what they are, but we also need to be honest about what they are not. We cannot say that because the building is in compliance with the model code, that it is necessarily safe. At an absolute minimum, the model codes barely consider contents, except when highly flammable materials or high value properties are involved.

Let us assume for a moment that on September 11, 2001, terrorists had infiltrated a pharmaceutical production facility and contaminated a quantity of flu vaccine and that 3,000 persons died and many thousands were injured. Let us assume then that the Federal Drug Administration conducted a thorough examination of the incident, and in the course of looking at the terrorist act, uncovered significant faults in the way those vaccines were being made and stored. What would the FDA do? Would they rely on a committee made up of pharmaceutical company executives and wait two years? No. They would order dangerous practices halted and they would look at accountability of the individuals who made the decisions, and they would base every decision on science. Many have tried to bully the FDA. It doesn't work because the public expects that the pharmaceutical products it uses are safe.

On any given day, relatively few of us are taking prescriptive medicine, but all of us are in buildings. Why shouldn't they be as safe as we know how to make them? Why should public policy consider food, drug, environmental, transportation, and personal safety as higher priorities than the way we build the places where we educate our children, work, live, worship, and play? As your investigation continues, we encourage you to help all of us to find the ways of ensuring that model codes are based on science, that economics are less of a factor, and that at the end of the day, we have some independent assurance that compliance means safety.

Dr. Hill: Thank you, Donald.

Next is John Flynn, from the Fire Department of New York. Is John here?

Okay. How about –? See if – John Flynn?

Is Peter Gleason here?

Peter Gleason: Yes.

Dr. Hill: Okay, Peter. Fire Department of New York.

P. Gleason: Good afternoon, ladies and gentlemen. My name is Peter Gleason, and I am a former New York City firefighter and fire marshal, as well as a retired military officer from the Coast Guard Reserve.

My background in the fire service has taught me two things, first and foremost, do the right thing. And secondly, keep it simple. It's obvious how these two principles should be the guiding force behind the reconstruction. And I will get to that in a few minutes. First, I'd like to share with you a quote. "Prosperity is a great teacher. Adversity even greater." If we don't take a step back and take the proper precautions, we are destined to repeat our mistakes. The most perfect example of this is the attacks upon the World Trade Center in 1993 and 2001. While the Port Authority could not have prevented the attack of 2001, and actually should be commended for some safety measures instituted after the 1993 attack. For example, after 1993 when a tenant moved out, the space was gutted to remove asbestos and also to retrofit and implement a sprinkler system. However, there is no reason the Port Authority should not have been held to the letter of the New York City building and fire codes.

Our society prospers as one based in the capitalist system, and as a society, we will overcome the adversity of those evil forces who want to destroy our way of life. But by building a structure that is not afforded the protections of stringent safety codes, this is nearsighted. And if the powers that be cannot or refuse to contemplate the preservation of life, then perhaps they

should put it in purely economic terms and adhere to building codes as a way to make a structure that lasts longer and is also cheaper to ensure.

The World Trade Center was built using components, which were classified as lightweight construction, as opposed to the Empire State Building, which was a heavier weight construction. Both buildings were hit by aircraft. In 1945, the Empire State Building was accidentally hit by a B-25 bomber. While the building sustained damage, there was never any question as to its structural integrity. The results of 1945 were due in part to the fact that it was of heavyweight construction. Nothing may stop the redevelopment of the World Trade Center utilizing lightweight construction. However, aside from the necessity of strict adherence to applicable building and fire codes, the federal government must also provide a military presence for the City of New York, or as some put it, the financial capital of the world.

As I mentioned earlier, I am a retired officer from the Coast Guard Reserve. One of my assignments was that of a deck watch officer on the cutter, Dallas, a 378-foot ship with anti-aircraft capability. This very ship was last home ported in New York Harbor in 1995, prior to the close of the world's largest Coast Guard base, Governor's Island. Had the cutter Dallas been in port on the morning of September 11, it would have been immediately put under way after the first plane hit the North Tower, and may have been able to engage the second plane. Instead, the people of New York had to anxiously await the arrival of fighter jets from bases some distance from New York City.

We must do what's right for the people of this city, and those who come here every day to earn a living. And the simplest way to achieve that goal is to implement and enforce a universal set of safety standards for high-rise buildings, which by the way, the federal government has both the power and authority to do under the dormant Congress clause, because the business that takes place within this city's high-rise certainly affects interstate commerce. Thank you very much.

Dr. Hill: Thank you, Peter.

Next will be Glenn Corbett.

Glenn Corbett: Thank you, Dr. Hill. Good afternoon, my name is Glenn Corbett. I'm Professor of Fire Science here in New York City at John Jay College of Criminal Justice.

I'd like to provide a few brief comments that are very specific and a very important issue, and that's what do we do at the end of this investigation come this fall? Since the very inception of the NIST investigation of the World Trade Center disaster, one of the primary objectives of the investigation was to develop recommendations for improvements to codes and standards, building design protocols, and emergency response procedures. It has also been central to the creation of the National Construction Safety Team Act. It is essential that these recommendations not languish, when they are produced, on the proverbial dusty shelf.

As we approach the completion of the investigation, it is critical that NIST publicly assemble a list of potentially impacted codes, standards, and practices now. Besides providing complete details as to how and why the disaster, the investigation itself must be organized and written in a manner so as to address these impacted areas. Once the investigation is completed, it is highly unlikely that we'll ever be able to go back again to ask additional questions to support code changes or improve emergency response procedures.

NIST has created a Dissemination and Technical Assistance Program, also known as the DTAP, which will work with industry recipients with the recommendations that are coming from this investigation. This effort is to be supplemented by an R&D effort, research and development effort, apparently for those areas of the investigation which will require additional time and expense to develop specific recommendations. What is critical about these two programs is that they must be timely, and that's the key word used in the invitation to this seminar, or this presentation today, the word timely, moving as expeditiously as possible.

NIST must also make the DTAP and R&D efforts much more transparent to the public. NIST should, in my opinion, begin by creating a separate web page on wtc.nist.gov. That is the web site dedicated to this investigation. That this separate web page should detail all the codes, standards, procedures, and the related organizations that will be impacted by this investigation. Not only will this let the investigators, but the public, as well, understand where these recommendations are going to be headed and who is going to be presented with them. Even more importantly, in the future, I would hope that NIST would actually use this as a tool to update the public on what code changes have been made. Unfortunately, as we all well know, code change procedures dictate that it takes a long time to move these things forward. It takes years to move these types of recommendations into the actual changes that we would all like to have. And I think having some type of mechanism to show that process and, again, to identify it to the public is critical.

NIST should also solicit the assistance of the various organizations that are the recipients of these recommendations. Literally, there are dozens of them. Compilation of this master list of impacted codes and procedures will help identify these groups. NIST should bring them all together, bring them under one tent in a public forum to construct a framework and assure these recommendations will be transferred quickly into the form that these organizations can accept. I am aware NIST has met with some of the larger code organizations, such as the National Fire Protection Association.

There are, however, many more organizations that must be brought under the tent. For example, in the case of the Trade Center, North Tower, it has been reported that several elevators descended to the lobby but the doors did not open to allow people to escape. It's estimated there were 200 to 300 people, perhaps, that were trapped in elevators within inches of survival. It appears also from these reports that a very specific device, the elevator door restrictor, which is actually part of a code called the elevator code, called the American Society of Mechanical Engineers A 17.1 code, played a critical role in preventing people from getting out of those elevators. While such a device, for example, is beneficial in keeping people from falling down elevator shafts when a car stalls, these devices may have made the elevator cabs inescapable and prevented rescuers in the same token from getting quickly to the people that were trapped inside, again, inches away from survival. It is apparent that this provision, as well as many, many, many others must be reviewed with respect to the WTC disaster for recommended changes.

The World Trade Center was a lightning rod for immense amount of safety issues, many of them long concerns well before 9/11. While the World Trade Center disaster has been termed an extreme event, many of the code and emergency procedure issues could have arisen in even less disastrous occasions. It is imperative that we thoroughly investigate the World Trade Center disaster, but more importantly, make sure that positive changes result, and it's up to NIST to make sure that that happens. Thank you.

Dr. Hill: Thank you.

Jake Pauls of the Jake Pauls Consulting Services.

Jake Pauls: Thank you. I apologize to those of you I won't be looking at while I go through this presentation, which has quite a few visuals in it. I am one of the consultants here today, but I'm certainly not selling consulting services in this area.

I've got 37 years of personal and professional concern in this area, essentially evacuation and life safety in buildings. And I'm also a member of the Skyscraper Safety Campaign, Professional Advisory Panel. Now, I apologize to many in the audience, because I am speaking most directly to engineers and scientists today, I have to use pictures. I found in the past that has been far more effective than data.

Now, there's a philosophical divide in the building safety community, and I'm going to use the analogy of the Titanic to describe that. There are some professionals and organizations that argue we don't need to consider a means of egress for high-rise buildings that we simply deal with prevention of terrorist attacks. Now that's similar to arguing after the sinking of the Titanic the problem was merely, was not inadequate lifeboats, it was simply the need for ships to stop hitting icebergs. Now, interestingly enough, there was the safety of live at sea provisions, which were drastically revised within two years of the Titanic disaster, two years, mark you. And here are some of the features beyond merely increasing the number of lifeboats that were brought in with that particular change. We have a lot to learn from that.

I'm going to stick with the analogy for a bit. Among the – one of the other lessons that were learned from the Titanic was, when the survivors reached port, they were immediately interviewed, and we learned a lot very quickly after their safe arrival in port. Now that raises the question, have NIST and other researchers "missed the boat" with delays and other problems with the other World Trade Center egress studies? Will this occur again after another future major evacuation, or indeed has it already occurred? Well, for example, it's my feeling very strongly that NIST should also have done the study of the major evacuations during the August 2003 power blackout, probably the largest set of urban and building scale evacuations we know of. Now, apparently having missed that boat, we also have, for example, in New York City, we have the expression a colleague of mine used, "people committing a lot of data"; Archie, 1976, a colleague of mine. We've missed, not only the August 2003 power blackout and evacuation, we've missed 2001. We've missed February 1993, and we also missed 1975.

And in terms of doing studies of the detail that I'll give you some pictures of here in terms of evacuation of people in large buildings. Now, how can NIST and other researchers be better equipped to document future evacuations in large buildings? One important tactic is to make better use of security or surveillance video systems. I've made this recommendation before. Exit stairs should be equipped with video cameras to monitor emergency egress, as well as normal use. And here's an example. And we can deal with the problem of ethics of human subjects research by simply pixelating the image, and you can identify the people moving down that stair, but you can't identify them as particular individuals.

Now because there is much to learn about how evacuees move in confined spaces such as exit stairs in high-rise buildings, NIST and other researchers should, as a matter of priority, convene a detailed discussion on human subject study methods for egress. This is extremely important. I was pushing for it two years ago. Differences among study protocols in the U.S., Canada, Europe, and elsewhere should be addressed in that. And especially important in this is to facilitate rather than impede with what are called institutional review board-based objections.

The IRBs have gotten in the way, for example of collaboration with U.K.-based evacuation researchers such as Professor Ed Galea.

Now, given the inadequate level of funding thus far for studies of the World Trade Center evacuation or for evacuation life safety generally, it's especially important to have maximum cooperation among researchers. NIST could and should do more to facilitate such cooperation, especially to reduce real or imagined IRB-based impetus international cooperation. Steps should be taken to address weakness in current NIST and Columbia University surveys of World Trade Center survivors into their evacuation. And specifically, survey respondents in the NIST study are apparently being asked to describe conditions in the exit stairs, using the photographs based on Fruin's classic work on levels of service, which you see it there on the left.

Now the problem with that is that's not a perspective of the evacuee. Much more useful is the perspective taken in John Labriola's photographs, or in any number of other photographs, some which are mine, of people in actual evacuations. And they should be used for determining what were the conditions during an evacuation. We're missing that in the current study. If currently being used, NIST should reconsider use of these overhead view representations for interview props, and NIST should use the more effective participant view representations. For example, such as created by the Exodus model, even if this means doing a subset survey to test effectiveness for further study. A failure to use realistic, graphic props that subjects can relate to, would suggest to me a general level of inexperience of NIST staff, advisors and contractors in the evacuation field, especially in the issue of evacuation dynamics in stairways.

Now, turning to NIST's role in code development, a few comments there. There is a need for NIST staff to become players in the codes standards making process generally, and not just after, not just after study results are in. Research findings are great as a basis for code development, but also important, proponents must be familiar with the code writing process, which I don't think they are. They are not involved, for example, haven't been involved in committees and hearings for the ICC, International Building Code, or the NFPA building construction and safety code. And if NIST wants to deserve its reputation for being an organization linking standards and codes and research, it must be, and be seen as, a regular participant in these processes.

NIST and NBS, its predecessor, have a history of contributing to the science and technology of building safety, although prior to 9/11, it had lost significant competence in human factors of building safety, which were particularly prominent during the 1970s. Now, in addition to that support of human behavior in fire, for example during the 70s, there was a landmark report in 1935, and I'm going to recommend here, after nearly 70 years, we should conduct a similar influential effort to collect and review what we know about evacuation in buildings and people movement generally.

Now, as a 37-year veteran in this business, I'd be pleased to participate with NIST first in a state-of-the-art meeting, or meetings, addressing what we know, what we need to know, and how we can best proceed with future studies of people movement and building safety. Secondly, we need to do a much better job of applying what is known, better codes and standards are one, and I say one, means to do this. To these ends, I've initiated with Bill Grosshandler a first-ever visit last month by four NIST staff to my office, which is an international center of information on people movement including evacuation. That meeting, although it has not yet resulted in a plan of action, serves as a beginning.

Now, having not been a leader in the people movement studies in recent decades, NIST should devote more resources to responding to opportunities and needs presented by people movement and building design construction operation and regulation. And that includes, for example, the issue of relative stair width, which I tend to have done a lot of work over the last 3-1/2 decades. That's an area NIST should also get involved. Here are some reference materials you can look at. I have a handout of those if you're interested. You can pick this up afterwards.

Just summing up the main points, NIST and others, and I'm focusing here particularly on NIST, should reexamine high-rise building safety generally. They should exploit evacuation study opportunities more than they have. They should solve problems of human subject study. They should use appropriate visual props in interviews, which they are not doing right now. They should participate more in building code development. And they should do a modern version, which I think some other speakers have addressed, of the 1935 egress study. And I'm referring here particularly to the egress area. Thank you very much.

Dr. Hill: Thank you, Jake.

Arthur Scheuerman, retired from the Fire Department of New York.

Arthur Scheuerman: I'm a retired battalion chief with New York City.

I was kind of amazed that the engineers still don't know what made this building collapse. This is my theory. Just for a second, I want to put it up there. The mystery about this is, number 1, Underwriters, the exterior columns, these are the bar joist floors that when they are heated up, the steel begins to stretch out, they begin to sag, and they begin to pull on the exterior columns. So in this situation, you have a three-floor fire, and there are three floors pulling in the exterior columns. Now, the second floor from the bottom is under compression because the column is being pulled against that floor. The bottom floor is under tension, because the column is being pulled out. You can see it's almost like a lever. If you have these three floors pulling in, and the pivot point is the second floor, and the bottom floor is under tension. If the bottom floor breaks or detaches or disintegrates, the column breaks right at that point or breaks all over this floor compression. Once the column breaks, there's nothing holding up the wall. The wall is holding up all the floors on the building, and the building comes down.

This is what I think happened in Tower Two. Tower One I have no idea because I have not seen the films yet. But my point is with this, potential pulling forces in the floors have been implicated in the collapse of the two towers and possibly with key mechanisms in the total collapse of WTC 7 and 5 and 6. There still appears to be a dispute on the magnitude of the pulling forces induced in long-span floors. The culprit here, I think, is the span.

It's a long span, the wide-open areas. You have very difficult fire condition, as was mentioned, in wide-open floor areas. It takes a long time to put out. You need a lot of hose lines. If you can't get them up there fast enough, you've got a problem. Testing of the 60-foot long span of floor systems under fire conditions has not yet been tested. We need a test that can measure what the forces are, and when the insulation fails on these beams, this is what happens. Over the last few decades, the building codes have been eroded by special interest changes. This has created a possible hazard in the new high-rise buildings, office buildings.

Fire resistance ratings: Fire resistance ratings for floors and walls have been significantly reduced from the previous code. Columns in the '38 code had to be four hours in endurance in the fire test. This was reduced to three hours in the '68 code, and two hours in 2001. Floors had

to be rated for three hours in the ‘38 code, two hours after the ‘68 code, and 1½ hours after 2001.

Now, 1½ hours is ridiculous. Tower One, the fire was raging for almost two hours. And the collapse, if that was built according to the code it would have collapsed. The code has to be changed. We have to go back to the old situation and put more insulation in this. Fireproofing requirements should be increased with suitable factors of safety to prevent fire and smoke spreading in collapse. Trade-offs for sprinkler system installation should not be allowed, since even though sprinklers are highly effective in controlling fires, they have been shown to be out of service about 16% of the time. In other words, 16% of the fires, after they get out of control, the building’s going to collapse.

The size of open office areas: Due to fire loads of paper, computers, desks, chairs, carpets, partition walls, the occupancies, the size of such office areas should be limited to assure rapid extinguishment. 2,500 square feet to 5,000 square feet has been recommended as a maximum for open office areas. Hardening exit ways, that’s been gone over. The sheet rock is inadequate.

(Thanks)

Exits and elevator shafts enclosures and corridor enclosures need to be hardened to ensure integrity from impacts such as smoke or natural gas explosions or heavy stream fire impacts even. This has already been changed in the New York City codes, which should reinstitute the hose impact tests that they used to have after the fire endurance test for walls and ceilings. They used to hit it with a hose at 60 pounds pressure to see what happens with the closure. That's been discontinued. If we don’t come up with an impact test, put that back in, at least.

Stairway ventilation: Some type of automatic and/or fire department controlled ventilation should be required over stair, elevator, and other shaftways. This ventilation is usually provided at the roof level, by the fire department opening the bulkhead doors of skylights over the shaftways. This is to relieve the smoke in the stairways. Smoke very often gets into a stairway, and naturally being hot and light in there, it rises up the stairway. If the top is closed, it begins spreading out on the floors. This is what happened at the World Trade Center. Besides the fire going through the floors, which seemed to be porous. Some automatic or fire department controlled mechanism should be provided to open the doors from a remote location on the ground at the fire command station.

Smoke-proof stairs: Smoke-proof stairs called fire towers with ventilated vestibule entrances that when required in the previous code. They’ve been discontinued. We have to have something similar to put back in.

Stair pressurization: Research should be conducted to determine whether stair pressurization to keep smoke out of the stairways to allow safe use for occupants has a detrimental effect on fire acceleration and spread or creates extinguishment difficulties with the door to the fire floor is open. These—a lot of times, when you open up a door to fight a fire, if you have a rush of air come in behind you, the fire is going to accelerate, and now you’ve got a problem putting it out. They have to do some experiments and find out how that works.

Dr. Hill: Arthur, can you wrap it up?

A. Scheuerman: Okay.

Stairway re-entry: Security demands that would convince code writers to allow required exit way doors to be locked on a stairway site to prevent people from entering floor areas from the stairways, except for designated re-entry floors required to be open on every fourth floor. Under present codes, once you enter a stairway to escape a fire, you may have to travel four levels to find an unlocked door to exit the stairway. Rapid exit may be necessary under conditions where a stairway rapidly fills with smoke, where it may become difficult to find an unlocked door in a stairway. This could be solved by requiring automatic fail-safe door lock releasing mechanisms activated by smoke and smoke alarms.

Dr. Hill: Arthur, can you wrap it up, please?

A. Scheuerman: Okay. I have a lot of other ones. If anybody wants a copy, they can e-mail me at acaj1@aol.com. Thank you.

Dr. Hill: Thank you.

Is Professor Zia Razzaq here?

Professor Zia Razzaq: There are many structural engineering issues, obviously, that have a lot to do with the World Trade Center collapse. My presentation is about one of those issues titled, "Non-proportional Loading Effects on Beam Columns Collapse in World Trade Center Towers." Now where the beam columns, actually all of the outer columns, as well as the core columns, were subjected to axial loads, vertical loads, as well as bending, because of the joist framing in. So any member that has an axial load and bending, is called a beam column. So, it's like a beam and like a column. In a layman's term, they're called columns, but really they're beam columns.

What is meant by nonproportional? Let me first explain the title. All of the building codes in the United States, and for that matter in the rest of the world, I have reviewed something of the order of 60 different building codes from 60 different countries, and all of them consider design of such members in building frames on the basis of the assumption that the applied loads are proportional; proportional, meaning what? Meaning the actual load, the bending or any other external loads are being incremented concurrently, simultaneously. They're all going up together, until the member collapses. Now, that is not what happened in the World Trade Center towers.

Okay now, so let me first just give you a beginning point for this. I don't expect you to be able to read that here, so let me just verbalize it. The vertical support system of the World Trade Center towers made use of hollow rectangular steel beam columns. The design procedures in all building cores of the world are based on the assumption that the applied load such as the bending moment and axial load, etc., are applied in a proportional manner. However on 9/11, the beam columns in the World Trade Center towers were subjected to nonproportional loads, the behavior and collapse of the World Trade Center beam columns cannot be explained accurately without considering the nonproportional loading effect.

Nonproportional meaning, you have a bunch of axial loads sitting on it, vertical loads, from the stories above, you have the bending loads coming from the joist and the other member framing ends. Those things are sitting there. Then you have periodic wind loads that come and go, so that makes the loading nonproportional. In case of what happened on 9/11, if you look at the sequence of events – if you could please go to the next slide – you had several nonproportional loading effects, and I have just outlined a few here.

Nonproportional loading effect A: After the columns were lost on the impacted face, the load from the upper part of the building on the remaining outer columns, plus the core columns, created nonproportional loading. So you have a whole bunch of columns blasted out from one side. And now, imagine columns on the other side, the far side, what are they experiencing? They were sitting there initially before the impact, carrying their usual loads. Now suddenly, a whole bunch of supports were lost. Now these columns are expected to carry additional load, because of redistribution of loads. Again, these loads came later on, onto those columns. It's like I am only carrying so many problems in my life. And suddenly somebody drops a bag of cement on my head, unexpectedly. Am I ready for it? Probably not. What I'm trying to say is, that the building code formulas do not give answers, or design formulas or design procedures that account for these loads applied in a sequential fashion, corresponding to the collapse conditions.

Okay. Nonproportional loading effect B: When the center columns collapse, the load path for the outer columns change again. So, the inside gave, and now the outer columns have yet a new scenario to deal with. It's like bag of cement on my head, my lumbar fails, and now what do I do? Now my knees are trying to support me, and suddenly my knee gives. This kind of a sequential, you know, degradation of the stiffness of the structure is not accounted for in the routine design procedures. Not only in the American specifications, but any specification of the world. So, I've heard of a lot of criticism against structural engineers, but they use what is based on the best known, best available information, based on whatever research was done up to that point.

Okay, let's go to the next slide, before I get too carried away. Back in the 1960s as a graduate student, I designed a machine there in Windsor, Ontario across the Detroit River on the other side of Detroit, in which I tested columns just like the World Trade Center columns, almost 37 years ago, hollow rectangular tubes, subjected to axial loads and bi-axial bending experienced by typical corner columns of the World Trade Center building.

If you go to the next slide: This actually was like a gyroscoping kind of a fixture that simulated the end boundary conditions, and I don't want to go into too much details, I think. Will you please go to the next one? This is a schematic of the end conditions, and really, I wasn't sure before I came to this meeting if the audience was going to be largely structural engineers or a mixture of a lot of people of different backgrounds, so I am guilty of having brought a bunch of stuff which is more suited for structural engineers, but could you please go to the next one?

This is a typical vertical member in the World Trade Center tower. You have a typical column and this rotational spiraling thing at the end, you know, represents the rotational restraints offered by the horizontal members. Go to the next one. This is a typical rectangular subassemblage in a space frame, and all of the symbols that I use in a thorough mathematical analysis based on systems of nonlinear differential equations with variable options, for those of you who are structural engineers.

If you go to the next one: This is a typical distribution used in a computer modeling for a typical hollow rectangular section, and this can be easily adopted to the World Trade Center collapse problems. This study, by the way, was done in the absence of fire. Okay, this was at room temperature. And even at room temperature, we found that nonproportional loading effects could cause premature failure of many of these vertical members. You don't even have to have a fire to kill those members. If you just, for example, instead of creating fire, if you just knocked

out a whole bunch of members from, you know, the side of the structure the way they were knocked off, without even having any fire, you would have potential disaster created in there.

Dr. Hill: Professor Razzaq, could you wrap it up, please?

Professor Razzaq: Yeah, sure. Okay, let me just really go to the – could you just flip? Yeah, just stay there. You know, the one prior to that? The prediction of how the material fails in a column is a very complex affair. Okay. In fact, Professor Theodore (inaudible) in 1909 received his Ph.D. from (inaudible) just to predict those (inaudible) lines.

So, the public is looking for quick and easy answers to these questions. These answers are not going to come unless and until public supports researchers through real funding that the federal agencies and the private industry must provide. In a nutshell, this is what I have to say. The problems are the size of an elephant, and the research funding is the size of an ant. And this is precisely the problem. And people still want tall buildings, and how are you going to design them? Well, you're going to use the formulas that exist based on semi-shotgun research that is planned and in the design codes. So you cannot have your cake and eat it too. You cannot push the engineers to do the right things, the code writing bodies to do justice to the proper design of these things in the presence of fire, and not really support the activity through proper funding so they can really come up with – some of my colleagues were saying – scientifically-based research, verified experimentally through laboratory tests. It takes –

Dr. Hill: Professor.

Professor Razzaq: – money and time and effort, and we need your support to be able to do that properly.

Dr. Hill: Professor Razzaq.

Professor Razzaq: One last comment.

Dr. Hill: Quickly.

Professor Razzaq: I am horrified with the idea that they are planning to build a new tower over there in the presence of such gross ignorance about so many fundamental things about structural behavior.

Dr. Hill: Okay. Thank you.

John Cole. Is John here?

John Cole: I'm John Cole from North Carolina. I'd like to extend my appreciation to NIST, to Senator John Edwards, and to the people of this audience who have a labor of love, a passion to serve the American people.

The speaker, who just spoke about research and the need for funding for research, really struck a cord with my heart on 9/11. First, I was in a state of shock as you were. Then I became angry that the terrorists could take our technology and turn it against us. And even though I'm only an electrical and plumbing contractor, a common person, I said somehow, somehow I'm going to study and research this issue until I come up with a solution. And friends, I'm here today because as I said, Senator Edwards and this agency has listened to the common man. I would

also like to express my appreciation to Rick Shibkowski (ph), Director of Homeland Security Weapons of Mass Destruction in Tennessee.

I went to studying how a conventional explosion could be contained, how to form a containment field, and I isolated the different elements and studied it individually. I didn't try to improve on an existing product. I had several in the defense industry say no one's going to listen to a common person, that won't happen. I'm here today because that did happen. Last January, I was invited to Washington by Senator Edwards where I was presented with a signed copy of the Building Security Act, U.S. Senate Bill 216. And that's appropriations going through the U.S. Department of Commerce for $40 million, which it's my hope that President Bush will sign that this research can go forward. And this funding that the last speaker spoke about, is funding that I am fighting for.

And I just want to express my appreciation here today and express my appreciation to you individually for the work you're doing. I know sometimes we have differences on our approach. But in common, we seek to serve the good of the American people. We seek to never allow this to happen to us again. And I'm confident because of what I've been hearing here today. I'm confident because of the research I've been watching put up on this screen. And not to put in a plug for myself, but I am running for the U.S. Congress, and if you want to look at my research relating to the idea, it's at coleforcongress.org. Seven minutes wouldn't be enough to touch the hundreds of hours I've spent doing research.

But like yourselves, I love this nation, and as I was walking – this is my first day in New York. And as I went to the site of the World Trade Center, I thought I knew what to expect. I was shocked. I mean, it doesn't matter how many times you see it on TV, or how many times you see it on the Internet, it still hits you. I didn't even know if I'd be able to stand up here and speak today because I've been trying to collect myself for the past two hours. But friends, I'm just here to extend my appreciation to this agency for what they're doing, and to you for what you individually are doing, because it's people like you who will make the difference.

Dr. Hill: Thank you, John.

We'll have one more talk before the break. Stephen Vassilev.

Stephen Vassilev: I want to thank Dr. Sunder, members and staff of the National Institute of Standards and Technology, and you, the audience, for this opportunity to comment on the World Trade Center investigation.

My preliminary comments are that, in general, the eight projects of NIST have advanced understanding of the factors and elements of the collapse and various fields of expertise have been utilized with beneficial progress.

I would like to focus on the direction the investigation should be taking under points 2 and 3, as well as on Dr. Sunder's Bottom Line December 2, 2003 which was and is: Make all buildings safer for occupants and first responders. Better evacuation systems and emergency response capabilities in future disasters. My e-mail to NIST on August 8, 2003, stated, "I have invented a building preservation system, actually a combination of new systems, that avoid progressive building collapse. Safe removal of building occupants in very short time periods, even when a building is struck by a major event, such as an airliner loaded with fuel."

Further innovations: Proper ways to design cities. Comprehensive defense plans of a city, and proper response sequences and systems to handle a 9/11 situation. And I add, the overall defense of a country. The events of 9/11 were catastrophic to thousands of people. It became an inherent drive to conceptually design safe buildings, and once the designs were realized, that anything less would be equivalent to criminal negligence causing death or bodily harm, perhaps to thousands of people. After designing these new systems, I then designed 10 interrelated World Trade Center designs that would incorporate these systems. With due respect to the labors and efforts of prominent architects and designers who submitted preliminary World Trade Center designs, as well as World Trade Center designs and the studies that followed, I was forced to agonize over the fact that:

1. All the World Trade Center designs submitted to the Lower Manhattan Development Corporation invite another 9/11 event. Please see www.geocities.com/bldgpt/index.html.

2. I had conceptually designed many World Trade Center designs that would avoid collapse. I sent e-mails to the LMDC in September and October 2002.

3. In February 2003 and onwards, I sent registered letters to the LMDC and other key people that I had design systems to avoid tall buildings from collapsing. The LMDC had already expressed its interest to have buildings erected that meet 9/11 event type safety criteria as laid out by the LMDC in the summer to fall of 2002. The new systems designed meet and even exceed the criteria.

1. Serve as a nationwide model.
2. This would include such things as advanced building design features that would protect occupants and emergency workers.
3. Allow safe egress in the event of a 9/11 type aerial attack or a large-scale interior explosion or fire.
4. Specifically, building structural integrity must be preserved through a combination of protected and redundant structural design and fire protection and smoke evacuation systems.
5. Safe egress must be insured for both the occupants that survive the initial event and access by emergency workers through a combination of redundant, secure, and accessible stairwells, or a highly protected elevator system.
6. Emergency communication systems must be operable and accessible by those in need.
7. Building and operation procedures must include provisions for response to 9/11 type events.
8. Including safe evacuation procedures and emergency access, including possible roof access and evacuation methodologies.
9. Also security long-term maintenance and all ADA accessibility standards must be carefully considered for all families.
10. Further standards, requirements, and specifications are lacking. The author knows he can far exceed the standards, requirements, and specifications suggested by his designs and inventions.

Several designs were submitted to the LMDC. Design 4 is on the web at www.geocities.com/buildingpreservationtech/index/html. This site shows five pages on how Design 4 succeeds where Libeskind et al.'s design fails, particularly on safety issues. Please see the vulnerability drawing with respect to Libeskind's design. Notice: The latest Libeskind and Childs of SOM revisions are still an invitation to a 9/11 disaster waiting to happen. Primarily, because of:
1. Vulnerability to 9/11 type attack.
2. Truck delivered explosives causing collapse, despite blast resistant walls and lower floors.

3. Lack of roof evacuation.
4. Building structure and shape.

Requirements to proceed are:
1. The signing of a confidentiality agreement. Publicly revealed, the knowledge remains patentable for one year in the United States and Canada, but not elsewhere, or becomes part of the public domain and marketability is lost.
2. A two-hour presentation format.
3. A joint venture with NIST and other parties to develop and patent the new building preservation systems.
4. Investigation by NIST researchers as to the factors and elements in the new World Trade Center designs.
5. Teaching the new technologies.
6. Gathering organizations, supervising the advances and building technologies into one representative body.
7. After input and responses, setting up new building and fire codes.

After about 1,000 pages of work on the new building preservation technologies, World Trade Center designs, World Trade Center memorial designs, nine responses to invitations to cultural invitations by the LMDC which included responses on building safety issues, I want to thank NIST for their attention to the new technologies so that these can be incorporated into more safely designed buildings. Thank you.

Dr. Hill: Stephen, thank you.

We'll have to stop at this point and thank you for your comments.

Let me tell you the schedule for the rest of the afternoon. We're going to take a 15-minute break now, and when we come back, there are three individuals who signed up at lunchtime to make formal comments to us. So we'll hear from those three individuals, and then we'll finish the day with any last questions and answers that you have for Dr. Sunder and the NIST team. So, let's get back at 15 minutes till 4:00.

Dr. Jim Hill: Take your seats please. As I told you, we had three people that signed up at lunchtime today to speak. And evidently a couple people signed up after lunch. So we have five individuals who have asked to speak, and we'll do the best we can to also give them seven minutes, and have enough time at the end to answer any last questions that people might have of this team.

We'll start with our first presentation, Bruce DeCell, from the Skyscraper Safety Campaign. Bruce?

Bruce DeCell: Thank you for giving me this opportunity to speak. My name is Bruce DeCell. I lost my son-in-law on 9/11. He was on the 92nd floor of the North Tower.

I suggest that one of the recommendations of the NIST investigation should be that the various levels of fire resistance, i.e., the hourly ratings, for structural members specified for various types of construction, be increased, especially for high-rise structures. The structural fire resistance must be commensurate with the amount of time necessary to fight a fire in that particular building. It is evident that it takes much longer to evacuate and to fight fires in tall and super-tall high-rise buildings than it does in low-rise buildings. However, at present, codes make

little or no difference between a 10-story building and 100-story building regarding fire resistance. This must change.

The National Institute of Standards and Technology has the opportunity to take a leadership role in acknowledging this need for change. NIST should address this issue, which critically impacts the safety and security of New York City's high-rise buildings, and in spite of recommendations, which will then impact both the ICC and the NFPA codes groups. Years ago, levels of fire resistance were generally downgraded by various codes groups, a move that was probably related to the increased use of sprinklers in high-rise and other buildings. Yet, we continue to subscribe to the dangerous practice of throwing all our protection needs into one basket and allow fire resistance standards to be lowered in buildings because they have a sprinkler system in place.

While I support the use of sprinkler systems, nonetheless, you cannot rely on them a hundred percent of the time. We all know how effective the sprinkler system was in those fragile World Trade Center buildings on 9/11. Unfortunately, some of us know this more than others. The premise is simple. The taller and bigger a building gets, the more additional protection we need to provide. Any fire department and fire protection engineer will tell you that fighting a fire in a low-rise building is different than fighting a fire in a high-rise building. Therefore, the standards must be different to match the different sizes of high-rise buildings.

Another standard that must be changed concerns the width of staircases. Staircase width must be increased to help evacuate buildings more quickly. This could make the difference between life and death in an emergency. We are counting on the NIST investigation to recommend widening staircases in high-rise buildings.

Regarding fire department radio communications in high-rise buildings, it is my utmost hope that this provision will receive close scrutiny from the NIST commission. The inadequacy of the fire department communication in high-rise buildings remains a critical issue that is characterized by dangerous shortcomings and inadequate technology in New York City today, and perhaps in other states as well. This must be changed and closely monitored for the safety of the public.

But no discussion of building code safety can be complete without referring to the fact that the very entity that sparked New York City code reform, the World Trade Center, was, and if allowed, will remain above the law. On 9/11/01 the Port Authority of New York and New Jersey’s World Trade Center buildings were totally immune from every single New York City building and fire code, and was subject to the Port Authority's own codes, which remain a mystery to this day, because no one has ever seen them. Under present law, the future World Trade Center will be just as immune as the old one was.

This must be changed. And I call upon NIST investigation to recommend that no high-rise building in the USA should ever again be constructed with immunity from local building and fire codes. The Port Authority repeatedly claims that they meet or exceed New York City codes. However, history has shown that this is a falsehood. No high-rise building of 100% bar joist floor construction, before or since the World Trade Center, has ever been allowed under New York City standards and practices. According to the NIST investigation, there is no evidence that fire tests were ever done on the fireproofing of the World Trade Center. This is a glaring example of a lack of code compliance, to say the least.

Finally, the untested fireproofing of the World Trade Center was grossly inadequate, a clear violation of New York City codes. However, since no fire department violations can be issued to

such an immune building, no codes violations ever were served on these dangerous buildings. Indeed, the fire department had no jurisdiction in the World Trade Center, but paradoxically they were required to risk and eventually lose their lives in these buildings. The Skyscraper Safety Campaign is presently involved is creating legislation to require the new World Trade Center will be constructed under the legal jurisdiction of New York City building and fire codes.

In closing, I must note that the economists among us may not want to spend additional money for the construction of a safe building. However, this must change, as the public demands it. In the past, codes groups worked clandestinely, and the American public was not aware that basically two groups, the ICC and the NFPA, held the safety and security of the American public in their hands. One of the outcomes of the NIST investigation should be to bring these groups out of the shadows and into the light, and to educate the public.

The American public is like a sleeping giant. When it comes to building safety and security, 9/11 changed everything. And along with it, the knowledge that the public will increasingly hold government agencies, builders, developers, municipalities, and codes groups responsible for the buildings which they live in, work in, and fight fires in. We could only get one chance to test and survive a fire emergency. In the post 9/11 field of building safety and responsibility, it is time to change the focus from economic considerations to ethical and legal responsibility for human life.

All those involved with the NIST investigation deserve the greatest thanks and support, especially those selfless individuals who had volunteered their time and expertise pro bono. We must also acknowledge the scientists and technicians and members of the public who volunteered information for this investigation. As to those individuals and municipalities or agencies who have not cooperated, the public expects NIST to use the subpoena power given to them by Congress, and to find the truth to thus safeguard the future. All of you must lead by example. The eyes of 9/11 and the people of New York City and indeed, the people of the world are watching you. Thank you.

Dr. Hill: Thank you, Bruce.

Roger Morse from Morse Data Associates.

Roger Morse: It's actually Morse Center Associates

Dr. Hill: Sorry.

R. Morse: I've taken a partner since last year. I have no slides of fireproofing or lack of fireproofing this time. I applaud what NIST is doing. I just have this sense of well being that NIST is actually going to do a righteous job on this, and some good will come out of the tragedy. That’s my hope for all of this. But there’re some things that weren’t specifically mentioned, that I would pray that you would consider and add to the list of things that you're looking at.

The first thing that occurs to me is that if the buildings had not collapsed, probably everybody that was on the floors above the fires would have been lost anyway. That's the general pattern that you find in high-rise buildings where the floors above the buildings become uninhabitable and the people die from smoke inhalation. I hardly imagine that people would have thrown themselves from the building if that wasn't going on before the buildings collapsed. So, it’s an easy thing to do add to performance specifications that the floors above the fire floor, or above a major fire, be habitable. And it’s something that can be done.

It's a relatively straightforward engineering exercise, to put that into some sort of manual for people to do. I think that's something for people to be able to accomplish that, I think that would be something that's of enormous good that NIST could look at, and could publish some guidance for the design community. Because you have to remember that the people that are designing high-rise buildings – I'm an architect, so I know what architecture school is like, and it's art school. It's not technology school. And when you're dealing with fire issues, you're really dealing with technological issues, so that some introduction to that is necessary to the architectural discipline, I think.

There was talk about elevators and studying elevators, and I think that's obviously a wonderful and necessary thing to do. But the habitability of exit routes, habitability of stair towers, and the habitability of elevators really needs to be considered, particularly for smoke ingress into the exit routes, in through shaft walls. Just as an example, if you have a shaft wall made out of drywall, typical Gypsum shaft wall, it's a very porous wall. A lot of air and a lot of smoke will infiltrate through that wall into the shaft. If you have a shaft made out of reinforced concrete, its much less permeable, and you really just have to worry about the doors. But if you look at the doors on a typical elevator installation, the doors are really just part of the flue to allow smoke to get from the fire floors to the upper floors of the building, rendering the upper floors uninhabitable.

So the people that occupy a high-rise building should be able to escape to the escape routes and find the places that could actually be used. The habitability of the escape routes needs to be addressed. It's less an issue in the World Trade Center than it is in many high-rise buildings, particularly high-rise buildings that are constructed with glass or glass and aluminum curtain walls. But the progressive fire spread vertically throughout a building, we've seen many high-rise buildings, building fires, when you get full floor involvement, which can happen from relatively simple means. If you remember the One Meridian Place, fire started with a bucket of oily rags and ended up with full floor involvement and the usual towering inferno situation with fire progressing from floor to floor. I think that's something – I didn't hear mentioned, and I think that's important for NIST to consider when they're looking at fire safety in high-rise buildings.

I didn't hear it mentioned, and I think it's another thing that's important to bring some more technology into the way that high-rise buildings are involved. Should be a code requirement that the structural impact of fire loads be considered during the design of the structure of the building, along with the dead loads, the live loads, and the wind loads. That's a simple thing to add to the building code. And it brings a whole other group of people into the design of the building, the people that are the fire protection engineers, and have that as their discipline.

We should consider regional differences. In high-rise buildings up north in the wintertime, you have a lot of stack effect going up in the building. Your smoke goes up. The buoyancy of the smoke tends to make it go up. If you're down south and you have a high-rise building and it's in the summertime, you have an air conditioned building, and you have airflow stack effect going downward through the building, which could confound the efforts to exit the building through the normal fire exiting.

The – and the final thing, if you haven't done it already, I would certainly encourage you to get a hold of a copy of the New York City Code Revision Task Force record. They developed quite a good record from a lot of people with a lot of experience in high-rise buildings, and I would suggest that you get a hold of those things if you haven't already. And that's all that I've got. Thank you.

Dr. Hill: Thank you, Roger.

Next we'll hear from Leonard Crisci, FDNY family member. Is Leonard here?

Leonard Crisci: Yes.

Dr. Hill: Okay.

L. Crisci: Thank you.

John Napolitano: I'm standing here with Leonard. Everybody has their bag of logs to tote, and Lenny has me.

L. Crisci: My brother, as you remember from before, is Lt. John Crisci from the Hazardous Material Unit who perished at the World Trade Center.

But what I would like to bring – just throw this out. I'm not an architect nor am I an engineer, but I'm a reasonable man. And I use that as a way of doing life. What a reasonable man would think and do. And part of it is this. When you look at the World Trade Center as a whole, this – the Port Authority and it's construction, and you read about it and you look into it, you see that what happened here, what occurred, was that the Port Authority took a – and the word is bad, conspiracy, because then everybody puts their head down. But they conspired to build this building using unorthodox ways.

And here, follow me, Yama, the architect, a small guy in a Midwest city who never had a big project, yet he is the one who sought out to build the Trade Center. He gets the job. Skilling, an engineer, again from a small firm out west, out on the west coast, he gets the job to be the engineer. And he brings in a guy by the name of Leslie Robertson, who's a college graduate, but at the time is not an engineer. Yet he designs the structure of the outer walls with the interior walls, the thin construction.

Then you watch what happens. Where do you get the steel to build this building? Well, you get it from United States Steel or Bethlehem Steel, the two number one in the world at that time. Remember, we were dealing in the 1960s. Japan and Korea were not a factor then. Yet, they go out and get bids from those two giants of steel are turned down because they say excessive. Yet they go out and get ten smaller companies, each one fractured all throughout the country, from Texas, to Seattle, to New York. They build the Trade Centers and they compartmentalize the building of the Trade Center.

A Pullman coach, who builds railroad cars, builds part of the World Trade Center. They get the contract. They build it. Now you've gone and you find the erector, Koch. Koch erects the building. When they bid out the process for the erecting, Koch is the only bidder. Why? Because no one else wanted to – they knew they couldn't get involved in it. Plus they were a small company with a lot of good background in the erecting business. They go on and erect the building. It was a foregone conclusion that they were going to go bankrupt, and which they did. They – well at least not totally, later on they went bankrupt. But they built the building.

The Trade Center was constructed at 60% of the steel in the first 12 floors. If you're getting paid by the tonnage, your money is gone by the time you reach the 13th floor. The next 100 floors were built with only 40% of the steel. The steel gets progressively thinner, up to a quarter of an inch when it reached the 110th floor. Then you bring this innovative – if you went out to buy a

washing machine today, and the salesman told you that it's innovative, never tried before, never done before, you'd probably walk out of the store. You don't want to buy it. Yet everything in the World Trade Center was innovative, never done before, new concept, excellent idea. The bottom line was that the Port Authority made a concerted effort to go and get small companies that were dependent upon the Trade Center either for their fame, fortune, or glory. That's how these guys – because everyone who was involved in it, except the big guys, Skilling and Leslie Robertson, they all went bankrupt.

In the book, "Men of Steel," by Koch, he brings out a very, very pointed story. He's in the business 100 years erecting steel. He brings his grandfather into the topping out ceremony. They pull his 90-year-old grandfather in a wheelchair out onto one of the floors in the mid building. This 90-year-old man who's been erecting steel for all of his life looks around and says to his son, "Where's the steel? Where is it?" And then the son explains, Dad – you know, Grandpa, it's on the outside and the inside. There's no steel in this building. What's holding it up? Well, what's holding it up was this innovative idea of truss floors, spanning 60 feet across, held onto by 5/8-inch bolts. This is what our loved ones were standing on and doing business on. That's why we're here.

J. Napolitano: No dedicated fire escapes. No cement. No concrete. Sheet rock walls to stop an airplane.

L. Crisci: You build a structure with high-speed elevators; encase them in sheet rock. Sure, it was a great – my thing has always been that if Robertson was a student at MIT, and he designed the World Trade Center as his Masters for his graduation class, he would have got an A from his professor. And he would have said, this is great. One of the best ideas I've ever seen. But on the bottom it would have said, it ain't gonna work. It's not gonna work. It can't happen.

J. Napolitano: And it didn't work.

L. Crisci: And you know what, it didn't work, because they murdered our family members by putting them in a building that they couldn't get out of when it came.

By the way, everybody who went and built that World Trade Center, all the contractors, nobody made money. The only ones who made money were the Port Authority. And why did they make it? Because they gave their tenants beautiful views with wide open, 209 feet of open views. They gave them – when that fire – when that plane hit, that plane, there was nothing to stop the spread of that fuel. It went across the floors. It ignited. It ignited everything on it.

Nothing was done to help us. When they built those stairwells, you know, they didn't give you a way out. They gave you 3, but no way out. You were dead if something cut off one of those stairwells. And they died. They died horribly.

J. Napolitano: The steel had a two-hour fire rating that they felt that it wouldn't fail and the building would stay up. But they knew from 1993, that it took over ten hours to evacuate. Do the math. And they sent first responders up there, and give them a window of two hours to get up 80, 90 floors to try to rescue people and get them out. All within two hours.

L. Crisci: What I ask you sir, and I know you're not investigating, you're not a criminal liability, but I say this to you. This was a – Austin Tobin, he designed this with the full intent, knowing what was going to happen. He did it economically then the Port Authority went with him. Those

buildings should have never been inhabited out there. All of our people who were – and you have to say that when it comes down. All these icons of industry, they gotta know. Because if – just think of the magnitude of that building. Why wasn't it full of New York architects and New York engineers? Why did they have to go out of town to get these people? Because those are the only people that could be brow beaten by the developers. They did what they had to do because that's what made them famous. And that has to be said.

Dr. Hill: Len? Okay, Leonard. Thank you for your comments. I appreciate it.

L. Crisci: Thank you for letting me have my comments.

John Napolitano: Thank you very much. I just want to say something really brief. My son was a first responder. He was with Rescue Two, Lieutenant John P. Napolitano. He was a husband, a father; two little girls. Lenny, his brother, John Crisci, Lieutenant with HazMat, also a father; three sons.

On the morning of September 12 Lenny and I got down there to search for our loved ones and some of the loved ones of you people here in this room today, and we never found them. At what they were calling "ground zero" at a triage area, I wrote a message in the ashes to my son. I thought if he was hurt and they brought him there that he'd see it and he'd know we were there. I just simply wrote "Rescue Two, John Napolitano, I'm here and I love you, Dad." I'm sure he saw it. Well, I'm here today on his behalf and his name, because if he could be here, he'd be saying what I'm saying today and what Lenny's saying today.

Gentlemen, listen, we know the buildings failed. There was a lot of expert testimony here. We know what we saw. We saw the buildings come down. The question is, was it an honest mistake on how they were made or was it criminal? And that's the question that has to be asked. Thank you.

Dr. Hill: Thank you.

William Rodriguez?

William Rodriquez: Hi, I'm William Rodriguez. I'm not with the FDNY. Actually I'm the last survivor pulled from the rubble.

I worked in the building for 20 years. I'm kind of here to pull NIST ears a little bit 'cause I was with you guys in Congress. I was here when you came the second time. And I was never called. I was never called for my testimony. In a sense, I've been the expert for the media, for the actual media, on everything related to 9/11 and the last moments of the people that were there. I worked in the building for 20 years. And I have one of the few master keys that were available on 9/11. And I was being followed by the fire department and the police – the Port Authority department on that day. I was opening the doors. And I know for a fact that you haven't called people that worked for structural employees.

If you go, obviously, to the supervisors, and you go to the company, they're going to try to keep this information. You should go directly to the employees that worked there for so many years. And get their experience. For example, I still have the pictures that I offered the NIST in Congress, on the hearings, of the stairs in the building. I still have them here. And I've never been called. I've got them all here.

Also, we told – ask the people from the asbestos removal business, because it was going on constantly. And that was one of the problems that I had with the – I was the person that cleaned the stairs in the building on the North Tower. And cleaning the stairs in the building gave me a personal look at what was going on. And I'm not an expert, but it made me an expert of what was happening that was wrong with the Port Authority. I remember on the 21st floor, on the 13th floor, there was structural damage on the staircases. I told this personally to Gene Morragio (ph) and Ed Strauss (ph) who are dead now, building operation managers of the Port Authority. And nothing was done with the structural damages. The stairs were cracking. The sheet rock, when I went up opening the doors, was falling on top of me and on top of the firemen constantly. And the swaying of the building made it easier for that to come off.

I remember listening to the fluorescent lights, the emergency lights that were in the building, cracking up in line; pop, pop, pop, pop, pop all the way to the bottom because of the swiveling. And one of the things, I mean, the sound of fear of the people on the floors was a constant reminder of what the fire department was trying to do that day, and the problems that we were experiencing. Not all the sprinkler systems worked. Not all the warble alarms on every floor worked.

The fire, the ball of fire, for example, I was in the basement when the first plane hit the building. And at that moment, I thought it was an electrical generator that blew up at that moment. A person comes running into the office saying explosion, explosion, explosion. When I look at this guy; has all his skin pulled off of his body. Hanging from the top of his fingertips like it was a glove. And I said, what happened? He said the elevators. What happened was the ball of fire went down with such a force down the elevator shaft on the 58th – freight elevator, the biggest freight elevator that we have in the North Tower, it went out with such a force that it broke the cables. It went down, I think seven flights. The person survived because he was pulled from the B3 level. But this person, being in front of the doors waiting for the elevator, practically got his skin vaporized.

And so what I'm telling you this is, as I went up – from that moment, I got this guy out. I went up, I went back inside the building through the basement. And there was people stuck on the lower elevators, the lower freight elevators that were in the other basements. And I saved two guys from there, they are alive right now, and they haven't been called to testify what they went through either. The problems they have when they went into the elevators, how they stopped working and things like that.

The fire escapes, as being the person in charge of cleaning them, I had constant problems with the Port Authority, constant problems because they didn't enforce, for example, the no-smoking law inside the stairs. I would have people in groups of five smoking on the stairs with trashcans inside the staircases, trashcans from the floors on a constant basis. And I will tell them, "You got to get out." They'd say, you're not a cop. Only on two occasions, because I took pictures, and that's the reason I have the pictures on the stairs because I didn't want to get – I was getting warnings from my cleaning company, constantly. You didn't clean these areas. Yes, I did. Yes, I did. But they will go back and they will do it. They will leave and they will do all these problems over there.

Dr. Hill: William, we obviously need to talk to you. You have some very valuable information. I have a note here that we attempted to contact you and weren't successful. Could you stay around afterwards so we could talk to you a little bit?

W. Rodriguez: Sure. I would be glad to. Okay, thank you very much.

Dr. Hill: Thank you.

Allison Crowther? Is Allison here?

Allison Crowther: Hello. I didn't come here today prepared to make any remarks, but I've been listening to everything that's been discussed. We lost our 24-year-old son, Welles Crowther, in the World Trade attack. He was an equities trader with Sandler O'Neill on the 104th floor of the South Tower.

For the first six months we just assumed he'd been lost with his company up above on the 104th floor, because we heard nothing. And then his body was recovered miraculously, we learned, on March 19, 2002. He was found with members of the command center that the FDNY had set up in the South Tower lobby. Why, you ask? Well, he was also a fully trained volunteer firefighter. So that's why the fire department must have let him stay. We then realized that he, although he was supposed to be in his office at about 9:00, that he actually had made it down to the ground floor.

Two months after that I was reading in the "New York Times," an article, and two eyewitnesses in an article extensively written by the "Times" and research, made reference to a mysterious man in a red bandanna who rescued people off of the sky lobby, 78th floor, making multiple trips from the 78th floor down to the 61st floor approximately, clear air, going back up, finding more people, getting them off and going back up yet again. Well, our son always carried a red bandanna. I called these eyewitnesses, and with current photographs identified, yes this was our son.

We have become very close with these two – the two ladies who came forward to say, yes, Welles did rescue us. And we learned some things in talking with them and other people. One of the things we learned, and I bring this up because of Mr. Paul's discussion about egress, the elevator banks from the top floors to the sky lobby, not all were in working order, even before the attacks began. There were elevators that were out of service, we've learned. The women that Welles rescued with a group of people they were with, not all of whom survived the collapse. Because he may have gotten off three people in the group, but only one came out, actually made it alive out. The others must have stopped to rest or whatever happened. But these people did not know where to go. They did not know where the stairwells were, the exits. Our son, because of his training and upbringing, knew always in every building he walked into, that was one of the first things he looked for were the emergency exits. But these people he was getting off the sky lobby did not know where those exits were.

We also learned that once down to the ground floor, people were being pushed back in. They were being refused exit from the building, even though they wanted to leave. Who these people were, whether it was Port Authority people, I don't know. But they were being told to go back to their offices, go back up. And stay inside the building. So we actually do know one person that did, got out to the ground floor, went up the South Tower, went all the way back up to his office on the 40th floor, and then miraculously was able to turn around and get out again. When he got home, we heard that man didn't leave his home for six months, as traumatic as that was.

So, yes the construction of the building is a critical issue, especially when we're building new buildings here and putting them up as high as the old ones. Yes, construction is a critical issue. But also I believe there's a real issue here with emergency procedure training and policy. That drills should be conducted thoroughly and on a regular basis with every company that's in a

high-rise building. And that building maintenance should be a very important piece of the accountability here, as well. Not just how it's constructed, but how they're maintained, and make sure that all these elevators are in working order. Thank you.

Dr. Hill: Thank you, Allison.

Okay. Thank you all. We had 25 formal comments today, in addition to a number of excellent questions. Now for the last few minutes that we have left, we want to open the floor up for any additional questions that you have of Shyam. And then he wants to make a few closing remarks.

And the first gentleman I'll call on, I spoke to at the break. So, sir, would you please give us your name and then make your comment.

Gerard Jean Baptiste: I'm Gerard Jean Baptiste. I'm the father of Gerard Baptiste, a firefighter of Ladder 9. He lost – he perished on the North Tower while helping to save lives on that tragic day. In his memory and in the memories of those who lost their lives that day, I hope that you find a responsible solution to prevent this tragedy from ever happening again. I heard a lot of testimony today, but I also want, not only we know what happened that day in that building, the failures of the building itself, but I want at the level of the fire department, those were with my son. I want to know the circumstances of his death. I want to know – I never know exactly what happened to him. I know he was there. I know he was saving lives, but that's all I know. I never knew what floor he was on, and what – some say he was in the lobby, some say it was the fifth floor. I want to know. As a father, I want to know that. So, I hope that the solution would be found to prevent this tragedy from ever happening again, so no father, no relative, can go through what I'm going through now. Thank you very much.

Dr. Hill: Thank you. Yes, ma'am?

Diane Horning: My name is Diane Horning. I lost my 26-year-old son, Matthew. He was on the 95th floor of the first tower. I had two questions and I don't know if they can be addressed or not. The first is, when I first attended a NIST hearing in Washington, I was led to believe that we do not in this country have an adequate fire testing facility. That we must go out of this country. I think there's one in Canada and one in Great Britain. Is this true? Is this still true?

Dr. Sunder: There are very large facilities in Canada and in Great Britain. And one of the two UL tests that we're conducting will be done in UL Canada. They have the larger 35-foot span trusses. What we have to do here in this country is only 17 foot.

D. Horning: So we don't have an adequate facility in this country? And that, I think should be addressed in your report. I think I heard that there was a great deal of cooperation with these other nations, but why we don't have it here is beyond me.

The second thing I wanted to mention was on page 13 of your initial document, sir. You mentioned the considerations for safety recommendations. And I think there's something that's missing. And I would hope that you would add it. And I may not be wording this right, but I think you need one more recommendation. And that is that you must require an immediate on-site inspection before the site is compromised. It was my understanding from that time in Washington that the inspectors were really not there for the first four months. And so you are in laboratories inspecting pieces that have been brought to you or that you have gone and reclaimed from some other location, but nothing on-site. The entire site was compromised before you could do your job. Is that true?

Dr. Sunder: Well, as you know, through the help of organizations such as the Skyscraper Safety Campaign, Congress, in fact, passed this new bill that gives NIST the authority to investigate building failures. That was signed on October 1, 2002. And now we have the ability and the power and the authority to go into a construction site within 48 hours and to take actions to preserve evidence and to interview witnesses. So, I think in a future disaster of any magnitude of this type, we will be in a position to respond very quickly.

D. Horning: How long was it in this particular case?

Dr. Sunder: In this particular case, we did not have the authority. So FEMA, the Federal Emergency Management Agency, through its authorities started an effort which led to a study and a report in May of 2002. That started in October of 2001. And Congress held hearings in March and May of 2002. And the result of that was the additional funding and the authority, as I indicated.

D. Horning: Thank you.

Dr. Sunder: So it took us a year, nearly, to get started. And that's really not acceptable.

D. Horning: No, it's not.

Dr. Sunder: Was not, and is not and should not be.

D. Horning: And I do want to reiterate about fire drills. My son, in the two years he worked there, told me he had never had an evacuation drill and, indeed, had never had a fire drill. And that's absolutely outrageous. Thank you.

Dr. Sunder: In fact, that's what we're finding as I indicated in the briefing this morning. Thank you very much for your comments.

Bob Thorne: My name is Bob Thorne. I really appreciate the opportunity to be able to speak today. I think the openness of this meeting is a very good thing, that the people who are allowed unrestricted use of video and audio recording equipment. Nobody was removed for saying anything controversial or for their misbehavior or anything like that.

I was wondering if it would be possible in the future to hold an open public forum between people such as yourselves who are experts and a group of other experts in the relevant areas such as were assembled to produce the final report of the bombing of the Murrah Federal Building in Oklahoma City. And have all these questions and discussions recorded and made available for public viewing. Substantial portions of the American public are aware of many inconsistencies and falsehoods with regard to Pearl Harbor, the Kennedy assassinations, the Martin Luther King assassinations, TWA flight 800, and the Oklahoma City bombing, and the investigations that took place with regard to those matters. As has been said many times today, the analysis of what happened in the World Trade Center bombing, or attacks, on 9/11 and the collapses of the buildings is a very complex matter, far more so than the other things.

And you the experts do not have all the answers yourselves, yet. And the audience – while there are a lot of people who are very well qualified, certainly not at the level of yourselves, the highest level of experts in these things in the world. Nevertheless, there are a number of independent groups of top-notch scientists and engineers from around the world who do have

this kind of expertise and have vastly different views of what happened on 9/11 and the collapse of the buildings, than what we've heard here today. These people are more on a level commensurate with that of the scientists and the engineers and those in the National Institute of Standards and Technology, and the others who presented today. These people will need adequate time for the preparation, notice, when and where such a meeting will occur in order to be able to be adequately prepared to best present their views on what happened. I don't think that happened with this meeting.

Finally, we were inundated with wall to wall coverage of the O.J. Simpson trial when that matter was relatively insignificant in the context of national importance or national security compared to the trial pertaining to the Oklahoma City bombing, the Murrah Federal Building. People were correct in questioning why there was the media blackout. That this was, with regard to the Oklahoma bombing, compared to O.J. Simpson trial. The one was insignificant. The other had great national significance. We didn't see an open trial about that. 9/11 and the World Trade Center collapses dwarfed those two other matters in terms of their complexity and the technical issues involved, and their national and international significance, as well. If ever there was a need for open public debate about the events of 9/11 and the World Trade Center collapses between panels of experts and professionals with vastly different views on what really happened, it's with regard to 9/11. Thank you.

Dr. Hill: Thank you.

Dr. Sunder: Thank you for your comments. You had a very far-reaching set of comments. And I think our focus is mostly on the building safety, evacuation, and emergency response. To the extent that your comments suggest, inputs from the public and openness, we're very open to inputs. We have provided contact information in my presentation. We encourage people, those who have information, to supply it to us, give it to us, and we'd be happy to talk to those individuals. And after the investigation is over and you're suggesting further groups of meetings of experts, we'll certainly take that into consideration as we go forward. Thank you very much.

Dr. Hill: Jim.

Audience Member (Jim Quintiere): Thank you, Dr. Hill.

Shyam, I have a question concerning funding. You mentioned that you have authority under this new act to do investigations. But I understand you have no funding for that. I've been at NIST for a long time before I left for the university, and I understand what funding can do in enabling you to carry out your mission. Now, many people have a lot of wishes for NIST in this particular investigation and in the future, because some of the speakers spoke about the process in the codes and how it's important to get technical input into the code process. Realizing that those that go to the codes that control it have vested interests. And nobody's really representing the normal public who just simply assumes that if the building passes the code, it's safe.

But we heard people say that the codes have been changed over the years. No one can articulate why. Even though it's an authority. So this seems like a bigger role for NIST and the building and fire program well beyond just this investigation. So I ask, in your recommendations and in your consideration of recommendations for this report, which will have a national and maybe even a worldwide audience, will you address the needed funding that will enable you to meet some of these wishes?

Dr. Sunder: I think both Congress and the Administration are aware of the needs as far as the World Trade Center response is concerned. With regard to the NCST and its broader – the National Construction Safety Team Act, and its broader funding, that's an issue that we're still trying to work out and sort out, both within the Administration and the Congress. Our advisory committee, whose Chair is sitting here today, has released its report, and made very clear what its recommendation is to the Administration and to Congress. So I –

Audience Member (J. Quintiere): But let's just go beyond that, not to investigative process but to the code process and the technical input into that. That is just not a one-shot deal or a shot from investigation to investigation. It's a continuous process that really needs to effect a cultural change. And that is really part of this investigation as well, because you're looking for recommendations. How are you going to be able to carry that out in the short term for the World Trade Center, and in the long term? I think it requires an articulation of funding needs, and will that be in your report?

Dr. Sunder: Well, actually, the WTC response plan, it has three parts to it. Jim was going to mention but probably didn't have enough time this morning. The first part is the investigation. The investigation is a $16 million two-year effort. There's a companion R&D program, research and development program. And you've heard some people talk about the various workshops we've held to bring industry, to stimulate the development of guidelines and the technical basis for standards.

And the third component is the dissemination and technical assistance program. That is going to help us get leaders of the construction and building community and the codes and standards organizations to help us work this. Now, our staff is committed. And I think at this point we have received some increases in funding. As you know, the budget is very tight. We have received a $3 million increase in funding in fiscal '03, which is continuing in fiscal '04, that is this fiscal year, in addition to the $2 million per year that NIST is putting into this effort. And the President has requested another $4 million increase next year. So with all of those funds, some of them are available this year and some are going to be available, we, I think, will be in a position, maybe not as fast as we'd like, but certainly in position to address your concerns.

Audience Member (J. Quintiere): Yeah, well maybe you can't put this into your report because it won't get by the Commerce Department. But Paul Fitzgerald is here, who's head of your advisory panel, and maybe he could put it, or consider that in the advisory panel recommendations.

Dr. Sunder: Paul is here and I'm sure he's heard what you said, Jim. Thank you.

Dr. Hill: Would you identify yourself, please?

John Woods: My name is John Woods. My son James, 26 years old, he was killed in the World Trade Center. He was on the 104th floor, Cantor Fitzgerald. Now I thought maybe he could make it out that day, but now knowing what we know, there's no chance.

What I'm going to tell you, you heard before. I worked on the fire department for 31 years. And in 1993 we were in the basement of the World Trade Center. Our radios didn't work. I had some people killed and I had to send guys out to the street, to make a long story short. And, well, I know what the fire department did in the past nine years with the radios. They didn't do anything. What happens with you guys? Do you have like – can you tell a Port Authority you can't build, or you know what I mean?

It's all great – you know, the stairwells were not – with sheet rock, the metal truss joists were horrendous. You know the stand pipe systems didn't work. You know, there was a million things that went on. Locked exits. But if they don't change the building – make the Port Authority adhere to the building code of the City of New York, what are we doing, what are we doing here? I was a young kid. I went on the fire department in 1968. John T. O'Hagan was chief of the department, he was begging them to put sprinklers in them. You know when they put them in, after '93. I mean, what can be done?

Dr. Sunder: Well, you make a good point. Unfortunately, I don't think we have all of the powers that you suggest we might – we may or should have. In the – unlike the Federal Food and Drug Administration, which is a regulatory national agency, both the National Transportation Safety Board and the National Construction Safety Team Act, which governs us, and was modeled after NTSB, do not give us regulatory powers. We are nonregulatory. And within the system of building codes and standards in this country, there are different organizations with different roles. The private sector groups such as the National Fire Protection Association and the International Code Council and a whole host of voluntary consensus standards groups in the private sector are the ones that develop the codes and standards. And then it's the regulatory authorities, and this is within our constitution, state and local regulatory authorities that have the job of taking and adopting regulations for their jurisdiction.

In the United States, we have 39,000 jurisdictions and over time, the country, the jurisdictions have recognized the need to aggregate so that we don't have disparate regulations. And I think over time, we now have more statewide codes as opposed to city codes. And with the move that the New York City has to try and adopt the International Building Code or similar kind of national code, I think you will see more uniformity across the country. But that is how the regulatory system works in this country. Unless we – what you're suggesting might require a total overhaul, but I'm not sure we're ready for that yet.

Dr. Hill: Sally?

Sally Regenhard: It's okay. That's all right. I'll stay right down here. You know, I need to just make a comment on what Mr. Woods said. I really think that, you know, the people in this room realize that your investigation is going to make recommendations, okay, and have findings. And we understand that you can't make codes, you can't force people to do codes. But you certainly can make a finding or a recommendation regarding building 110-story buildings that are totally immune from building and fire codes, which have no oversight, which no one knows what they are made of, how they were made, and so on. So I think the people following this investigation, and I think Mr. Woods is looking for the leadership in recommendations about should the tallest and highest buildings in the world be immune from building and fire codes? So thank you for that.

Dr. Sunder: Sally, we'll certainly consider that suggestion that you have. And I think you know that we won't be satisfied at NIST until we know we've presented the most probable technical cause of the collapses of those buildings, until we have recommendations that are meaningful and that can be implemented. And until we see those who are charged with public safety carefully considering those recommendations and adopting those recommended changes in practice. So we're going to work on it.

S. Regenhard: Okay. Thank you. I just wanted to get to my statement that I wasn't able to finish when I was, you know, speaking before. But there's one very important thing that I have to raise

that no one has raised here. And it's something that all the people in this audience really need to know, and I'm sorry that everyone still isn't here.

We all know, certainly parents and families of firefighters know that 9/11 was a disaster. It was a disaster from the top of the administration of the City of New York, to the fire commissioner, to the chiefs in the fire department. It seems as if no one knew what they were doing. There was no plan. No one knew what was going on. The radios didn't work. There was no communication. Now that we know. However, because most of the people are dead who really experienced this, there's one way, a wonderful way, that we can find out what happened in the building. What happened with the radios? What happened with the chain of command? What happened with the lack of integrated command structure? And that is the 911 tapes and oral interviews of the 500 firefighters that were done right after 9/11.

But I'm going to get back to the 911 tapes. I don't know if the people in here know, but there are so many tapes going back and forth. Port Authority tapes, City of New York tapes, police, this and that. You know what? The system has succeeded in mind boggling the public. We don't know what tapes are what, who has what, and what was given, and what wasn't. But I will tell the audience here that the 911 tapes, the 9-1-1 emergency transmissions and oral interviews, the City of New York for the past 2½ years has refused to turn them over to the public, to media, to the NIST investigation and to the 9/11 Commission.

Now, you would ask yourself, why? Why would the City of New York not want these things to be made known? Well, that is a very good question. Why indeed? The fact of the matter is that the City of New York has held onto these for 2½ years, has refused to give them to this federal agency and to the 9/11 Commission on terrorist attacks. I have to tell you that that was our last hope. I am one of the 45% of all the families of the victims whose loved one has never been recovered. I am one of the over 110 firefighter families who has had not one single word from the fire department. No one ever told me what happened to my son. Where was he assigned? What time did he get there? Which building did he go into? People are asking me where was your son? I say, I don't know where he was.

But I wish – if we could listen to those 911 tapes, maybe somebody would know where my son was. Maybe the truth about the radios would come out. I want to tell you the City of New York has refused, refused, and refused. The New York Times brought a freedom of information act lawsuit. The Skyscraper Safety Campaign and ten families of the victims joined this lawsuit because we have a right to know. We want to know.

I must tell you also, and I'm very disappointed. I know that you are doing the best you can with this investigation. But I have to tell you, I am terribly disappointed that the 9/11 Commission and your investigation, instead of holding your ground, demanding those tapes, demanding them for your scientific investigation, your investigation and the 9/11 Commission capitulated to the mayor of New York and to the powers that be, who want all the truth and the facts suppressed. I have the right to know. I am an American citizen. I am a person who believes in this constitution. My son served this country for five years in the Marine Corps, and unfortunately, for a little over five months in the fire department. Yes, my right to know is being held down.

This NIST investigation agreed to a censored truncated version of the 911 tapes with – the City of New York insisted that "emotional language" be deleted. Emotional language? If you were in a building and you were trying to communicate with somebody and your life was hanging on a thread, you wouldn't use emotional language? That's absurd. Also removed from these tapes was people's judgment. So if a seasoned firefighter for 30 years on the job called through the

radio and said I can't hear anything, these f-ing radios, it's chaos down here, we don't know what to do; that was removed too.

I mean, really, Dr., Dr. Sunder, how in the name of God can a scientific body like yours, and the 9/11 Commission is even worse, but we're talking about this investigation. How can you, in looking for the truth, in trying to find out what happened, and getting all the facts, how could you have agreed to this? We fought to give you subpoena power. You could have used it. I want to know why you didn't use it, and I want to know why you capitulated to lies and silence and secretiveness and keeping the truth from the American public?

Dr. Sunder: Thank you very much for those comments, Sally. I know you feel very much about what you're saying. I do want to say that with – that New York City has offered us access to the unredacted 9-1-1 tapes and the unredacted transcripts to look at, after we're done reviewing the redacted information, at their offices. So we will be looking at it.

S. Regenhard: Does that make any sense to you, because it doesn't make sense to me? It's like, it's like a – I don't know what that even means, though.

Dr. Sunder: So, well that's where we are. And I think we will have access to the unredacted information to resolve any questions that may remain after we study carefully the redacted information.

S. Regenhard: Well, I just want to say thank God for civil rights. Thank God for Norman Segal. Thank God for the courts. We're going back. We're going to appeal it. If I have to go to the Supreme Court of the United States, I'm going to find out what happened in those buildings on 9/11. And I wish that your organization and the 9/11 Commission had the guts to do the same. Thank you.

Dr. Hill: Olwen?

Olwen Huxley: Hi. I'm Olwen Huxley. I work for Congressman Sherry Boehlert of upstate New York, although he's very fond of you downstaters. He's also Chair of the Science Committee that oversees NIST and created the National Construction Safety Team Act.

I want to talk about the future. Who's been tracking the federal budget deficit lately, anyone? Has anyone been following the federal deficit problem? Okay. Well, pay very, very close attention. If you want to see NIST get any more funding for any future involvement in building codes, I suggest you get on the phone or get to your word processor, contact the Appropriations Chairman of the Commerce Justice State Subcommittee of Appropriation on the House and Senate side. And if you don't know who they are, go to the web and look them up. But Chairman Wolf from Virginia, Chairman Hollings on the Senate side. He's the Democratic side. I work on the House side. I tend not to bother the Senate side too much.

But the main point being that since we are in very, very tight budget times, and of course everyone says that every year, but this year it's for real. NIST is being offered an increase by the Administration of $4 million to be involved in various standards and codes practices with applications to buildings. Unless some people stick up for NIST's budget for a change, that increase will not happen because there is no money and they are looking for places to cut everywhere. And believe me, if they're starting to talk about cutting the defense budget, don't think that any of the civilian accounts are going to be immune this year.

NIST got a significant cut in its budget, purely accidentally last year, a cut from which they are reeling. If they don't get any kind of restoration money, it's unlikely that they will be able to do any of the things that you have said that they should be doing, including participating in any of the international codes council activities with respect to buildings, fire codes, etc. So, you know, it's not a very pleasant message, but you've asked NIST to do a number of things going out into the future. And unfortunately, they may have to start laying off scientists this year. It's very difficult for them to justify things like international travel to meetings in Europe to participate in standards development activities. But that's fundamental to what you guys want to see come out of this investigation.

So support NIST. I know that they have annoyed you in a multitude of different ways, and they have been very frustrating. And maybe their inability to communicate with the public has caused you a good deal of grief. But if they can't take what they have done, annoying though it may have been, and change the building codes that you have so roundly criticized, it's not going to mean very much. So that's what I have to say.

Dr. Hill: Yes, ma'am?

Eileen Walsh: Yeah, the name is Eileen Walsh, and I'm the mother of firefighter Michael Brennan who perished on 9/11 from Ladder 4 and Engine 54.

Unfortunately, I've been at a couple of hearings. And it seems, you know, investigations 40 years ago, before the Trade Center was built, they didn't want it built because there was controversy over it. How it was being built and the different codes being used. Now here we are 40 years later. How many millions of dollars were spent since 9/11 on investigations over building codes and everything else that if you would have listened to the experts back then, who were on the fire department and the engineers and people who had integrity. If they would have listened to them then, we wouldn't even be here today. And you would have saved a hell of a lot of money. Now we have to spend all this money on investigations.

And my question is, is the Trade Center being built currently as adhering to what codes? – Their own codes. So what are we doing here? Twenty-five years later, we're going to have our grandchildren, I lost a son, I don't want to lose a grandson 25 years from now. So this seems like it's in vain. Sally Regenhard has worked effortlessly for two years and I commend her and I back her for it. And many people in the fire department that I know, the mothers and the wives who lost people, you know, they feel hopeless coming to these things and supporting you, because, you know, what their interest – for what?

Because the developers are behind everything. Because if you don't make the money, it's not going to go up quick enough. And they wanted this Trade Center put back up quick enough, because now when your investigation is done, what the heck good is it going to do because the buildings are up already? You know; so everything is like, well, yes, pacify them. You have an investigation. You give millions to this, millions to that. Meanwhile, all of these buildings, all this construction is still in the process. You know, it takes common sense. I didn't send my kids out to play in the snow without a glove on. You don't put up a building without the right materials. That comes down to integrity. That's all I have to say.

Dr. Hill: Thank you. Shyam, we have some time for closing comments.

Dr. Sunder: Yes. And I will – I want to make a comment on this most recent set of comments.

Sometimes the change in the construction industry is slower than we'd like. Obviously we'd love to see the new construction using the thoughts that we've come up with, the findings we've come up with so far. And we're open to the developers to come and talk to us, in terms of technical work and what we have found and help them. We have no problem with that. We don't have a regulatory authority.

Just to give you an example of the 1994 Northridge earthquake. And in that earthquake, what was found were problems with steel moment connection building frames. You know, these steel frame buildings that you see all the time, there were problems with those buildings. And it's now after a 10-year research and development effort that the American Institute of Steel Construction is getting ready to issue, next year, standards that incorporate the lessons that were learned as part of the 1994 Northridge earthquake.

It does take time with a normal process. And I think what we are talking about is trying to speed up that time. And I think what we're saying is, if we have the resources, we'd be very willing to do – and even with the existing resources, we are very willing to pursue whatever justified changes there are that come out of the investigation we're currently doing.

Audience Member: But why then is the Port Authority given the (inaudible). Why do they still have the responsibility to oversee what's going on now? If there was question and doubts about what was done, (inaudible) why then are they still in control of what's going on? I mean, someone gave them power back then to do this. Now they still have it.

Dr. Sunder: Let me try and give you the context for it. And we don't have a solution here because I think that's part of our constitutional system. State government, local government, and federal government are separate domains, and one doesn't regulate the other. And the Port Authority was set up as a particular part of the U.S. Constitution that involved a compact between the State of New York and the State of New Jersey. So it was established under a separate charter of the Constitution. And so it's not governed by the State of New York or by the local City of New York. So there are jurisdictional issues in the way the organizations were set up under our constitutional form of government. And so we have to visit that issue to resolve the kind of questions you've raised.

Audience Member: Do they set up landlords and builders or do they set up (inaudible) for education?

Dr. Sunder: Now I'm going beyond what I should be talking about.

Dr. Hill: We're getting a little bit beyond our area of expertise.

Sally Regenhard: You know what? Excuse me. I want to add just one thing. I just want to tell you so you'll feel a little better. We – the Skyscraper Safety Campaign and families of the victims filed a lawsuit against the Port Authority challenging their immunity from building and fire codes. Unfortunately, we weren't successful. That's okay. We're not giving up. Now, we have joined with New Jersey assemblymen and New York assemblymen and two Congressmen to write legislation to change the law and to remove the immunities from the Port Authority when it comes to commercial development. It's up to all the people in this room, the families of the victims, when this law comes out, and we will be letting everyone know, to contact your elected official, your assemblyman, your state senator, and get after them and make sure they support this. We can change the law. That's what the Constitution is about. Hey, you know what? That's what we're going to do. And that will change it. Thank you.

Dr. Hill: Shyam?

Dr. Sunder: Thank you.

Dr. Hill: Your comment?

Dr. Sunder: I will now have closing comments.

First of all I want to thank every one of you for coming. I think you've provided us with tremendously useful information as we go forward over the next 6 or 7, 8 months of our investigation. Many of those comments which were supportive of what we do, obviously we like. Those comments which say we ought to do more and better and different things, we take very constructively and very seriously. And I assure you that my team and NIST will take those into serious consideration, and the members of the advisory committee who are here will make sure we follow up on those recommendations that you've made. So I want to assure you about that. We take your time and your effort very seriously.

As we go forward, I think the only other comments I will make are that we have tried and we will continue to be open as we have been in providing data and putting more data in the public record. We issued one interim report last May. Another one is scheduled for the spring of this year. We have also had two public updates, written documents that are on our website, as well as detailed briefings over a day or two at three advisory committee meetings. And all of that information is available on our website. We have been very open. We are open to discussion. And we'll continue to be open. All we do is, once our reviews are done, we get them out as fast as we can. So I promise you, we'll continue to do that without compromising the progress and outcomes of our investigation.

And all of the suggestions you've give us today, we will make sure the appropriate investigator who is responsible for it, and in some cases that might be me, in some cases it might be Jim who has to weigh in on things, we will appropriately take our responsibilities and make sure those suggestions are carried forward. So thank you very much for your time and patience and effort.