U.S. NUCLEAR REGULATORY COMMISSION

25th ANNIVERSARY OF THREE MILE ISLAND UNIT 2 PRESENTATION

March 3, 2004

11155 Rockville Pike

Rockville, MD

PANEL MEMBERS:

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KEYNOTE SPEAKER:

DR. J. SAMUEL WALKER, NRC HISTORIAN

P-R-O-C-E-E-D-I-N-G-S

Chairman Nils Diaz: Good morning, ladies and gentlemen. And welcome to this morning's event. This morning is one of those things that we commemorate but I'm not sure that we celebrate. I'm really pleased to welcome you to this special presentation that marks the 25th anniversary of the accident at Three Mile Island Unit 2 Nuclear Power Plant near Harrisburg, Pennsylvania.

Joining me on the platform this morning are my Commission colleagues, Edward McGaffigan, Jeffrey Merrifield, the EDO, Dr. William Travers, and -- for those of you who don't see him often but you are going to see him a lot today -- the NRC historian, Dr. Samuel Walker whose book entitled "Three Mile Island: A Nuclear Crisis in Historical Perspective" has been published by the University of California Press.

Our purpose this morning is to take a retrospective look at some of the key events of the accident as seen through the eyes of a professional historian, to discuss some of the significant regulatory improvements that the NRC implemented following the

accident from the perspective of the Commission and NRC senior staff, and ultimately to ensure that the lessons that we learned painfully so many years ago are shared with the staff and with the community, sharing our continuous responsibility to protect the public health and the safety of the environment from the potential hazards associated with the commercial uses of nuclear energy.

On the morning of March 28, 1979, no one, not even the employees of Metropolitan Edison Company inside the Three Mile Island who were trying to understand and address a series of confusing and anonymous alarms registering on the control room annunciators, recognized that a nuclear accident of historic proportion was well under way. Indeed, few experts thought that such a severe accident was ever likely to happen.

Statistical analyses had estimated that the probability of a major accident was 1 in 3,000 reactor years of operation. Commercial nuclear power industry safety records perceived to be outstanding. And the Atomic Energy Commission, and a successor agency, us, the Nuclear Regulatory Commission, had put in place a

regulatory program based on the concept of defense-in-depth in which a series of redundant engineered safety features in theory would either prevent, altogether, a major accident, or mitigate its consequences.

Confidence in the technology was very high, in fact so high that the NRC, the industry, and the state and local governments had devoted only minimal efforts to such important non-hardware issues as emergency planning, the potential for human error, operator training for emergencies, and what we call today safety culture, or even better, safety management. Yet, within a few days after the onset of the accident, it became clear that an unthinkable severe accident in the form of a seriously damaged TMI reactor core had happened within the first few hours of the accident on March 28. A safety system cannot perform its intended safety function if it's not allowed to operate. Defense-in-depth, therefore, by operator actions, was seriously challenged. However, the TMI containment, the third barrier of defense-in-depth, was called upon and performed its vital role.

Was the TMI-2 accident inevitable, given the

complex technology involved in producing electricity from nuclear energy? In a very real sense, the answer is no. Subsequent investigation revealed that at various points, as the accident unfolded, effective measures could have been taken to bring the reactor under control and break the accident sequence. There is one thing that we have learned from TMI in all of these many years, that there is time. And if we use time effectively, we can make good things happen.

But these measures were not taken, had less to do with the technology than with human error driven by a lack of understanding or, at times, a profound misunderstanding of what was taking place in the core during the first few hours of the accident.

In another sense, however, the accident may have been initiated by itself by the widespread over confidence. Complacency was the word choice of the Rogovin Report in both industry and government, that the redundant engineered safety feature would work as designed and that successful operating experience in the past signaled competent management at nuclear power plant sites. Neither assumption would prove to be true. The lessons

were there. They were painful. But we all did learn. And I am confident that we learned well. However, since then, I think that the words of "trust, but verify" are very, very appropriate.

The work goes on. Technology has improved. And so have we. But as the historian Arthur Schlesinger once noted, science and technology revolutionizes our life, but memory, tradition, and myth frame our response.

Consequently, the 25th anniversary of the TMI-2 accident offers all of us a unique opportunity to revisit the causes and consequences of the accident. It is also a fitting point in time to renew our commitment to the NRC primary objective, the protection of the public's health and safety, and to remind ourselves once again that we have new challenges to meet and old promises to keep to the American people.

We will begin our program this morning with a historical overview of the accident. As Chesterton once suggested, the disadvantage of men not knowing the past is that they do not know the present. History is a hill or high point, a vantage from which men see the town in

which they live or the age in which they are living.

Our man on the hill today is Sam Walker, our NRC historian. I do not know what Sam wanted to be when he grew up, but we know now what he is. He is an extremely qualified and expert historian on the issues of nuclear radiation, in fact, one of the foremost experts in this country, on nuclear radiation in general.

His new book represents a most comprehensive look at the historical impact of the TMI accident produced to date. I would like to point out that we are going to have a panel once everybody has completed their addresses. At which time I will moderate that session. So we will hold questions until that point so that we can get through with the presentations.

And without further adieu, please join me in welcoming Dr. Samuel Walker.

[Applause].

Dr. Samuel Walker: Thank you, Chairman Diaz. I like it when he talks like that. I liked the last part especially. Actually, what I wanted to be when I grew up was a center fielder for the Detroit Tigers. But

becoming the historian of the NRC was a very close second.

It's my pleasure to welcome you this morning to the latest installment of NRC History 101. I'm glad to see such a good turn out this morning, though I must confess that I suspect that some of you are here in hopes that if you listen to my talk you won't have to read my book. So I guess in that sense this is kind of a Cliff's Notes version of Three Mile Island.

As you know or I hope if you know by now -- and if you don't know, you're in trouble in NRC History 101 -- we are rapidly approaching the 25th anniversary of the accident at TMI Unit 2. In a short time, the accident was the most harrowing, gut-wrenching, and bone chilling crisis in the history of commercial nuclear power in the United States bar none. In the long run, it had a greater impact on the nuclear regulation than any other single event in the NRC's history. And therefore, a general understanding of what happened and why at Three Mile Island on the morning of March 28th, 1979 is important, indeed essential, for all of us who work in the field of nuclear safety.

As a historian, I would also argue that a basic understanding of the causes and consequences of the accident is also important for those who don't work in the field of nuclear safety. It is one of those heart stopping events that is deeply etched in public memory. And unfortunately, the etchings are sometimes widely inaccurate or badly distorted, especially after a quarter of a century.

Chairman Diaz has just talked briefly about the causes of the accident and I'm not going to do that in detail. I try to do that in my book. But as you know or you should know, if you're historians or lawyers you might not know, but what happened was that a pressure relief valve on the pressurizer stuck open. It should not have done that. This allows coolant from the core to escape out of the open valve through the pressurizer and quickly set off a loss of coolant accident, the kind of accident that nuclear experts in the AEC, the NRC, and the industry have tried for years to avoid, the worse kind of accident they had imagined. And yet the events that occurred at TMI on the morning of March 28, you had a loss of coolant accident that became increasingly

severe as more and more coolant escaped out of the open valve.

Unfortunately the operators in the control room, as alarms were going off, as lights were flashing, as it was clear that something was happening, that something serious was happening that required prompt corrective action, did not recognize what in fact was happening. They did not recognize that it was a loss of coolant accident.

And there were any number of reasons why that was not clear. But the most apparent, I suppose, was that there was no clear indicators in the control room to tell them what was going on. There was no signal that indicated clearly that the presser relief valve on the pressurizer was open. There was no gauge that showed them what the level of coolant was in the core. And their concern, as the alarms kept going off and the lights kept flashing, was not that they were undergoing a loss of coolant accident but that there was a real possibility that the pressurizer was going to go solid, that the pressurizer was going to fill with water. And this was something which they had been trained to

avoid at all costs.

And so what they did was to take action to try to keep the pressurizer from going solid. And what they did, in order to try to make certain that this did not happen, was to turn off the emergency core cooling systems that were flooding the room, sending the water into the core as a result of the loss of coolant accident.

So within a few minutes after the accident occurred, the operators took action that, in fact, greatly exacerbated the effects of the accident and lead, within a couple of hours, to a meltdown at the core.

So on the morning of March 28, because of mechanical flaws and because of operator actions that were the wrong actions to take, what you had on the morning of March 28 was a meltdown, the exact thing that nuclear experts had tried for years to avoid. And that's exactly what happened as a result of the massive loss of coolant accident.

What we know now was not so clear to people on the morning of March 28th. No one knew, until 1985 in fact,

that the core had suffered a meltdown. It was clear by later in the morning of March 28th that there was a problem with getting coolant to the core. It was clear that there had been a serious accident. But no one knew at that point, or at any time during the five days of crises at the TMI Plant, that in fact the core had suffered a meltdown. And I think it's safe to say, and all the people who I talked to when I was doing my book made it clear that if they had known that the core had melted, they would have ordered a wide scale evacuation of the population immediately. But no one knew that at the time.

In fact, by the evening of March 28, when operators finally managed to get one of the reactor coolant pumps turned on, they had worked all day for almost twelve hours to try to get -- the pumps had been turned off too, because they were vibrating so severely. Finally, after a day long to get the pumps back on, on the evening of March 28th around 7:30 or so, they managed to get one of the reactor coolant pumps back on which allowed the coolant to flow through the core again and appeared to stabilize the reactor. No one thought that

the crisis was over, but they did at least have some reason to think that the worst of it was over, that the plant was now more or less stable, and that the plant was more or less under control. And from that point on, it was going to be mostly a question of recovery, of cleaning up the plant and getting it back on-line again.

And on Thursday, the second day of the accident, the second day of the TMI crisis, this was still pretty much the conviction among Med Ed and NRC officials, that there had been a serious accident, that there was damage to the core but it was damage that could be repaired, it was damage that could be corrected, and the plant was more or less under control.

It wasn't until late on Thursday afternoon when a sample was taken of reactor coolant which read about a thousand rads per hour, along with the fact that the thermocouples in the core were reading at extraordinarily high temperatures that the NRC and Med Ed and others who were involved in responding to the accident had realized that we've got something that's quite serious. And so that's when things started to get geared up for a major response to what appeared to be a major accident.

And it was this background then that lead to the events of the day that has gone down in the annals of TMI as Black Friday. Black Friday was Friday, March 30th, what was really the third day of the accident. And Black Friday started off, routinely enough, when operators in the control room decided that they had to vent radio gases out the stack of the auxiliary building, in order to relieve pressure on the primary system. And they did this because they thought that the primary system, if the pressure were not relieved, that the flow of coolant to the core was likely to be reduced or interrupted. So they had been doing this on occasion on Thursday as well. So this was not something new. It didn't seem like a big deal.

And so on Friday morning, about 9:00 in the morning, they opened a valve which allowed radioactive noble gases to escape out the stack. There was a helicopter right above the stack which took a reading of gases that were released at 1200 millirems per hour, a large reading as you all know, but right above the stack. And they expected this, the operators expected there to be a fairly high reading above the stack. But they

were consoled by the fact that at the ground level, a the same time, the readings were only about 12 to 14 millirems, not something that you want to have necessarily, but not a dangerous level either.

But it turned out that this action on the part of the operators on the morning of Black Friday set off a comedy of errors. It was a comedy of errors which was not humorous at the time, and even 25 years later is not exactly amusing.

Operators had informed state officials of their intention to do this release, but the message that they passed along to the state got terribly garbled. The message got to Oran Henderson. Oran Henderson was the head of the Pennsylvania Emergency Management Agency, PEMA. And Oran Henderson in turn reported to the Lieutenant Governor of Pennsylvania, William Scranton, that, quote, there had been a large release from the cooling tower. Of course, he didn't quite have that right, but the word got through that there had been a large unplanned uncontrolled release from the plant. And the Lieutenant Governor Scranton in turn passed this on to Governor Thornburgh and told him that there had been

an uncontrolled release and that things at TMI looked a lot worse than they had appeared the previous day.

So the message that the state had about what was happening at the plant on the morning of Friday March 30th was inaccurate, to put it mildly. And it was based on a great deal of misinformation. The same thing was happening with the NRC. The NRC, at that point, had -- and I don't know the exact number, perhaps a couple dozen, staff members at the site. But the decisions were still being made at the incident response center in Bethesda. And the NRC staff in Bethesda had not heard in advance about the planned release and got the word from Carl Abraham who was a Region I Public Affairs Officer whose was asked by Paul Critchlow who was the press secretary for Governor Thornburgh, what's going on with this release, you know, what's going on with this uncontrolled release of 1200 millirems per hour from the cooling towers kind of thing? That's the way the message was conveyed.

So Abraham called Bethesda to find out what Bethesda knew. And what Bethesda knew was nothing. All they knew was that there had been a release from the plant of 1200

millirems per hour. And this was a source of great concern, as it properly should have been.

And so very quickly, the senior staff in the Incident Response Center, who included the EDO, Lee Gossick, the head of the Office of Nuclear Reactor Regulation, Harold Denton, his deputy, Edson Case, the head of the Office of public affairs Joe Fouchard, and John Davis, who was the acting head of the Office of Inspection and Enforcement agreed that they should recommend to the state of Pennsylvania an evacuation. And they didn't exactly say how far out the evacuation should go but perhaps out to ten miles. And they did this on the basis of the information that they had, which was extremely fragmentary, incomplete, and in some ways inaccurate.

But they couldn't get better information because they couldn't get through to their colleagues at TMI. And the reason that they couldn't get through was that the phone lines were all busy. There were no dedicated phone lines. There were no cell phones. There was no other way to get through to their colleagues at the site except to call them on the phone. Well, unfortunately,

by that time PEMA had put out the word, through its civil defense structure on the radio, that there might have to be an evacuation of the population. So the phone lines in the Harrisburg area were completely jammed. So when NRC officials in Bethesda tried to call their colleagues at the site close to Middletown, they couldn't get through. And what they knew was that there had been this large release. And they were concerned that, one, the release was uncontrolled, two, the release or the measurement of 1200 millirems per hour might be on the ground, it might be off-site, and it might be the first of many such releases.

And so based on that fear, based on that uncertainty, the NRC staff in Bethesda decided to take the most cautious possible position and say, let's evacuate, let's advise the state to evacuate. And keep in mind that the NRC's role in here was strictly advisory. Governor Thornburgh from the first moment, always had the final authority, the final say, on whether an evacuation would be ordered. So the NRC staff, without checking or being able to check with their colleagues at the site, at TMI, or without

consulting with or getting the concurrence of the Commission, decided to advise the state to undertake an evacuation.

And the reason -- again Harold Denton tried to call the Commissioners who were on their way to their offices which were downtown in Washington and couldn't get through. So the staff acted without consulting with or even informing the Commission. And if you'll look to my right, you'll see the Commissioners turning just a little bit pale at the thought that the staff had taken this action without even consulting the Commission.

So Harold Denton in the Incident Response Center in Bethesda asked "Doc" Collins, a staff member in the office of state programs, to call the state and advise them that it was the NRC's position that the state should order an evacuation. And Collins told Henderson, with whom he talked, out to ten miles. And Henderson said, well we're not ready for ten, maybe we'll do five. And Collins says, well that's fine but you might have to do ten, so start thinking about that. And that's the word that was passed up to Governor Thornburgh very quickly.

And Thornburgh then was faced with a decision, does he order an evaluation or not. And Thornburgh, unlike the NRC officials in Bethesda, was acutely aware of what the potential costs of an evacuation might be; costs in terms of human lives, because, if you have an evacuation, it could very easily turn into a panic, especially if people are afraid of radiation or don't know exactly what they're dealing with. That can cause accidents, car accidents. It's likely to cause a certain number of fatalities. No one knows how many, but still some fatalities. It's likely to cause injuries. It's certain to cause economic dislocation and loss. And it is certain to cause severe hardships for the population of Pennsylvania.

So Thornburgh was not going to order an evacuation according to the advice he got from the NRC without knowing what the basis for it was. And he made that very clear. And in fact he kept asking his staff, because they said, well, Harold, "Doc" Collins called us and advised us. And he kept saying, well, who is "Doc" Collins, you know who is this person? And he later made clear to me he wasn't casting dispersions on "Doc" Collins

or the NRC staff. But he said, I'm not about to order a major evacuation of the population of my state without knowing who this person is, what his authority is, and why he's telling me to evacuate.

So at that point then Thornburgh decided well, what I need to do is to talk to the Chairman of the NRC and find out what's going on. So Thornburgh made a phone call to the NRC Headquarters in Washington. The Commission meanwhile had arrived at their offices, and they had gotten the word from the staff in Bethesda that they had advised the state to evacuate because of the information they had gotten about the release from the plant. And the EDO, Lee Gossick, told the Commissioners that, quote, there had been an uncontrolled release, and two, that, quote, all hell had broken loose. So this was the word that the Commissioners got when they arrived at their offices on Black Friday. And they were trying to figure out what the NRC's position should be because they knew that there had been a release of 1200 millirems. What they didn't know was what the cause of it was , what the duration of it was, how likely it was that there would be further releases of some magnitude

of that or a greater magnitude. And they didn't know where the measurements were taken; on the ground, off-site, on-site, above the stack, whatever. They simply didn't know.

So the Commissioners, like the state and like the NRC staff, is trying rather frantically to make some decisions and to gather information about what was going on in order to formulate a position and give informed advice to the Governor. Well, it was at this point that Governor Thornburgh's call came in to Chairman Hendrie. Hendrie, in fact, had been trying to reach Thornburgh for some time but couldn't get through because the phone lines were still all jammed. So finally, Thornburgh managed to get through to Hendrie. And he said, Mr. Chairman, I have to know what the basis is for your recommendation that I order an evacuation out to ten miles. And Chairman Hendrie had to say, I'm sorry, I don't know, I'll have to get back to you on that.

And if you look at Chairman Diaz, I think he's turning even more pale at the thought. And Chairman Hendrie was caught in a terrible position because he didn't know. And he couldn't answer. And he promised

to get back as quickly as he knew something to give informed advice to the Governor. But as you can imagine, Governor Thornburgh, who was not happy at that point anyway with the NRC, was furious.

When I talked to him when I was doing my book he said, You know, I don't think I was very nice to Joe Hendrie that day. And I said, Well, yes, sir, that's true. And he wasn't. But he was in a terrible position. I mean, he had to make a decision based on a little information, and the pressures were enormous.

Thornburgh also said that Friday morning was the worst day of the crisis for him. He said, compared to what was happening on Friday morning, the hydrogen bubble just didn't seem like that big of a deal. It did to others, and I'll talk about that in a second.

Well, eventually what happened was that the state got better information. The NRC got better information. It did become clear within a fairly short time that the 1200 millirem measurement had been directly above the stack, that ground level measurements were much lower, that there was no major crisis, that there was no need for an immediate large scale

evacuation.

But it was also clear, on the morning of Black Friday, that conditions in the plant were much more uncertain than anyone had realized prior to at least Thursday evening, that no one knew exactly what the condition of the plant was, that no one knew exactly what was happening in there, and that no one knew exactly what had to be done in order to bring the plant under control.

So it was on that basis then that the Commissioners and the Governor agreed that it would be wise, that it would be prudent for the Governor to order a partial -- or to recommend -- it was an advisory evacuation, but to recommend that the Governor advise the most vulnerable members of society, pregnant women and preschool aged children, to evacuate from a file-mile radius around the plant. And it was on that basis and for that reason then that Governor Thornburgh held a press conference around noontime on Friday and made that point. He said we are not advising this because radiation levels were any higher than there were the previous day, which they weren't. But he said, in order

to exercise upmost caution, I'm advising those members of society who are most susceptible to injury from radiation to evacuate until further notice.

So there were about 3500 people, pregnant women and preschool aged children, who evacuated as a result of the Governor's advisory on Friday afternoon. They were joined by about 70,000 other people who were not pregnant or preschool age but were greatly concerned about what was happening at the plant. So Black Friday was the day then of the partial evacuation. And that's how it came about. If there had been more time, if there had been more information, if there had been more communication -- many if's, it never would have been necessary. But that's how it came about.

It was also on Friday morning that President Carter got involved in responding to the accident for the first time. When the White House heard about the release on Friday morning and the word was passed along to the President -- and Carter, of course, had been in the nuclear navy, so he knew that a measurement of 1200 millirems per hour could be serious stuff. So at that point he called Chairman Hendrie on the phone and he was

able to get through. I guess the White House had better luck than others were having. But he had a lengthy conversation with Chairman Hendrie. And Carter promised to do a couple of things that were important. One was to send up a White House team to install phone lines. And they were up there by early Friday afternoon, and they installed a dedicated phone line between the NRC trailer at the site, the White House, the State House and Bethesda. So this was enormously helpful.

The other thing that Carter asked was that Chairman Hendrie send the best person in the country to go up there to the site to oversee what was going on. And Chairman Hendrie said, well, I could send Harold Denton or I could send a senior member of his staff. And at that point you don't have to read between the lines of the transcript of this conversation too much to see that Carter was losing patience with this whole thing. And he said, may I suggest that you send Harold Denton? And Chairman Hendrie said, yes, sir.

So Chairman Hendrie called Harold Denton and said, Harold, you're going to TMI. So it was at that point that Harold Denton, accompanied by a dozen or so

staff members, flew in a White House helicopter to the site. And Harold Denton, at that point, became the President's representative at Three Mile Island and really took over NRC operations there.

By the time that Denton got to TMI, things had more or less calmed down after the excitement of the morning that lead to the evacuation recommendation. But also, at about the same time, at least in Bethesda, there was growing concern about the presence of a hydrogen bubble in the pressure vessel of the plant.

By Thursday evening in fact, it was apparent that there was a large hydrogen bubble in the vessel, large enough to pretty much fill the dome of the vessel about a thousand cubic feet. And the concern with the pressure vessel, with the hydrogen bubble at that point, was that it would inhibit cooling of the core, that the vessel was, quote, non-condensable, but there wasn't any way that you could just puncture the hydrogen bubble, and that it could expand, and if so, it was inhibit, perhaps prevent cooling of the core and block the flow of coolant to the core. And in that way, in a worst case, could even lead to a meltdown. That was the

concern on Thursday. And keep in mind, again, that no one knew there had actually been a meltdown. So they were still trying everything they could to avoid a meltdown.

On Friday evening or by Friday evening, another potential problem with the hydrogen bubble became a major source of concern for Chairman Hendrie. And that was that the process of radiolysis, in which water molecules are broken down into hydrogen and oxygen, that this process could lead to the creation of free oxygen in the hydrogen bubble and that this might create a volatile mix within the hydrogen bubble.

And Chairman Hendrie who, as you all know, was very highly regarded for this technical acumen, both by the NRC staff and the world at large. He was just a marvelous engineer and scientist. And Hendrie kind of did some back of the envelope calculations and thought, there could be the evolution of enough free oxygen here to cause a problem. And the problem that they were concerned that it might cause was to make the bubble flammable, which wouldn't be good, or over a span of time, several days, probably that it could even make the bubble explosive,

which you certainly did not want to happen. So Chairman Hendrie instructed Roger Matteson who had been working on various problems dealing with the plant, he asked Roger Matteson to coordinate the efforts to find out if in fact the NRC should be worried about the hydrogen bubble and what the risks were, what the dangers were that the hydrogen bubble might in fact become flammable, or even worse, over more time, explosive.

And the basic question was, would the rate of evolution of free oxygen in the bubble, with the rate of evolution from radiolysis, proceed at a faster rate than the recombination. Everyone in the NRC knew that some of the oxygen, perhaps a lot of the oxygen that was created through the process of radiolysis, would recombine with the hydrogen in the bubble to form water again. So if that's the case, then it's not a problem. But the question which was much more uncertain and much more complicated was, would the rate of recombination be the same as the rate of evolution? And if the rate of evolution of oxygen is greater, then you have this free oxygen there. And that's what can cause a problem.

And this was not a simple calculation. It was not

something that was immediately obvious. The NRC called experts around the entire country. The staff did all kinds of calculations trying to figure out if there would be free oxygen. And there were some people on the staff and outside who said no, it's impossible in a hydrogen rich environment like that, you're not going to have any free oxygen so you don't have a problem. But there were other experts, including some of the best experts in the world who said, yes you could have the evolution of free oxygen at some point within a few days or a couple of days, you could have enough oxygen to reach a flammable condition.

No one knew at that point, or later for that matter, but no one knew how this volatile mix could ignite. But the fact was that they were worried about the evolution of enough free oxygen to cause a major problem.

So while the NRC was working on this, Chairman Hendrie -- this was on Saturday now, Chairman Hendrie held a press conference. And he held a press conference against his better wishes and his better judgment. And the press conference -- he later told me, he said, yeah,

that press conference was a disaster. And the reason why it was a disaster was that the reporters -- it was here in Bethesda. And it was held with the reporters who were covering the TMI story from Washington. And they were clamoring for somebody they could talk to in a position of authority locally. So Chairman Hendrie, as the Chairman of the Commission, felt as though he should be the one who should meet with the press.

What happened was that in response to questions, Chairman Hendrie said, quite truthfully, yes we are concerned about the hydrogen bubble, we are concerned about a hydrogen bubble that could potentially, worst case, become explosive. So one, you had official acknowledgment, in spite of caveats, many caveats, that you could have an explosive bubble. And Chairman Hendrie also said at that press conference that if we have to take action to get rid of the bubble at some point, we might have to recommend an advisory evacuation of the population of Pennsylvania out to 20 miles. So here you have the Chairman of the NRC saying yes, we are concerned about an explosive bubble, worst case; and two, if things get worst with the bubble, we might have

to recommend an evacuation up to 20 miles.

Well, within a short time after Chairman Hendrie's press conference, a veteran reporter for the AP, Stan Benjamin, wrote a story which included many caveats. And it was not written in a sensational manner, but the lead of the story was that NRC thinks the bubble might be explosive, and two, that it might reach a critical point -- he used the term "critical point" without saying what that meant. It might reach a critical point within two days.

And what happened was, as soon as he filed that story, the lead for the story was sent out on the wires. It was sent out with advice that this was a really hot story. And the lead of the story without the full story or without the caveats was soon broadcasts on radio stations within the TMI area. And the lead was, NRC fears a hydrogen explosion at TMI, and it could happen within two days.

Most of the residents of the area got their information from the radio. But those who didn't have their radios on had their TV's on Saturday afternoon and Saturday evening and could get the same news by

watching the streamers running across the bottom of their TV sets that says, "NRC fears hydrogen explosion in two days."

Well, as you might imagine, this caused a great deal of anxiety in central Pennsylvania. This was as close as the population ever came to panicking, and with good reason. Anyone with half a brain, I think, would be concerned about this. And the concern was not only that something was happening at the plant that might release a lot of radiation. I mean, that's what the NRC was concerned about. But the way that the story was reported also conjured up images of a nuclear bomb explosion at Three Mile Island. And there's no way to measure this. There are no polls that show how many people thought that TMI could blow up like a hydrogen bomb. But there's no doubt in my mind that many of the people who were so fearful on Saturday afternoon and Saturday evening at TMI were convinced that the danger was not a massive release of radiation, but a nuclear bomb explosion at Three Mile Island.

In the middle of this growing crisis over the hydrogen bubble, President Carter decided to visit TMI. And President Carter did this

because he thought he should show his concern for what was happening. And he did this after his staff called Denton and Victor Stello. Stello was Denton's right hand man at the site, and asked them if they thought it was safe. And they said, yeah, it's safe. They were not concerned about the hydrogen bubble as a near term problem at all. They thought it might be a long-term problem. And in fact, the staff at the site -- and they didn't have a radio or a TV in their trailer, so they didn't even know about the hydrogen bubble panic that was going on in the Harrisburg area until they got calls from the White House and from reporters.

The hydrogen bubble issue and its concern about a hydrogen explosion at TMI has been the source of drastically flawed commentary in several books that were published shortly after the accident and in TV programs on PBS in 1999, NBC Dateline in 2001, and The History Channel, which was broadcast recently and still might be. I have not looked for it, but it still may be right there on your cable line-up. And these programs charge that, even as President Carter was flying to TMI for his visit on Sunday morning, that the NRC was fearful that a

hydrogen explosion in the plant would occur at any moment, at virtually any second, and could seriously threaten the lives of both the President and his party and the residents of central Pennsylvania. The History Channel, in its program, places the bubble not in the pressure vessel but in the containment building. And it shows a diagram where it shows the top of the containment building being blown off by this hydrogen explosion and then radiation spewing out throughout central Pennsylvania.

Well, this presentation of the dangers of and the fears about the bubble are wildly off base. The NRC was concerned, on Saturday and Sunday, about a flammable condition in the pressure vessel and the bubble in the pressure vessel. They were concerned that, in a worst case, if the bubble was flammable and if there was some sort of an ignition mechanism, that if the bubble burned -- that you might get a pressure pulse that might cause loss of the pressure vessel. Then this puts the core in the containment structure. And you don't want that. It doesn't mean that the containment is going to be breached, but it certainly does increase the dangers and

certainly does increase the possibility that there's going to be a breach of containment and a major uncontrolled release this time of radiation to the environment. So that caused a great deal of anxiety and loss of sleep among NRC officials, especially in Bethesda, on Saturday evening. But I reiterate that the problem was not that anyone at the NRC was concerned or had reasons to be concerned that there was a near term threat of a bubble that was going to cause the plant to go up in flames on the spur of the moment. And, of course, there was no concern that the plant was going to blow up like a hydrogen bomb.

Harold Denton told Stello on Saturday evening, after learning about the panic and after holding a press conference with the Governor on Saturday evening, Denton asked Stello to take another look at the bubble issue and see if there was -- he said, I want to make certain that somebody didn't know something that I didn't know. So both Denton and Stello at that point were convinced that you would not have the evolution of enough oxygen in the bubble to cause even a flammable condition, certainly not an explosive condition. But

Denton quite properly told Stello to take another look at it.

And Stello asked Mat Taylor who was one of the staff members at the site to investigate the issue once again. Taylor spent all night making a lot of phone calls to Bethesda and to other experts around the country. And by eight o'clock on Sunday morning, Taylor had reached a conclusion that, quote, the staff in Bethesda, quote, didn't know what the hell they were talking about. And he told this to Stello. And so at the site NRC experts were convinced that the bubble, at least in terms of being flammable or explosive, was not a problem.

Meanwhile, the NRC staff in Bethesda, who had been calling around to experts around the country, had received information that the bubble might in fact be coming close to if not reaching a flammable condition, that there was an evolution of free oxygen in the bubble and that the bubble might actually be flammable. So here is the NRC staff in Bethesda thinking one thing, the NRC staff at the site thinking something else. And President Carter is about to jump on his helicopter to

fly on his visit to Three Mile Island.

So what happened was that Roger Matteson and Joe Hendrie hopped in a car, an NRC car. I'm not sure who the driver was, but they drove at a very high rate of speed from Bethesda to the TMI site. In fact, they were pulled over by a police officer. I mean, they were driving extremely fast. And the police officer said, what's going on here. And they said, oh we're NRC officials and we're on our way to Three Mile Island. So he said, okay, go ahead. So they did. And Roger told me that they made it up there from Bethesda in an hour. I haven't done the calculations, but if you've ever made that drive you know that it's not easily done in an hour, even on a Sunday morning.

So Hendrie and Matteson got to the site. They sped up there in order to inform Denton of what the experts with whom they had been talking had concluded. They were greeted by Denton and Stello. And Stello and Matteson had a very vociferous argument on the spot because Stello was convinced that there was no chance that there was a flammable bubble, that there was no evolution of free oxygen in the bubble. And Roger,

who's not an expert but was bringing the best opinions of experts around the country -- and as you know, neither Stello or Matteson was exactly a shrinking violet. So they were having this very animated argument, and there's poor Harold who's standing there, and he has to brief the President whose helicopter is about to land. And Harold has to explain to him, you know, what the situation is with the bubble.

The argument between Stello and Matteson has gotten a lot of attention in these TV programs that I just mentioned a couple of minutes ago. But contrary to what those programs say, Matteson and Stello were not fighting about whether they were going to die in three or four minutes from a hydrogen explosion, with the roof lifting off the dome of containment and the plant going up in into flames. But they were arguing about the condition of the bubble and what that meant in terms of the possible risks of something very serious happening at the plant.

Well, what happened was that Harold Denton did exactly the right thing when he briefed the President. He said, there are two points of views about the

condition of and the dangers of the bubble, and he explained what Roger had said, he explained what Stello had said and let it go at that. And the President, who was very well informed and asked good questions, knew what the situation was.

It was later that afternoon that, when Stello and Hendrie went back to the NRC trailer and Stello called some people who he knew at Westinghouse and Bettis and other places, and they confirmed his opinion that there was no evolution of free oxygen in the bubble at all. And Stello convinced Hendrie that that was true. And Hendrie later said it was obvious, at that point, there was never anything to worry about.

And by that time, Roger Matteson had gotten a ride from somebody back from the airport, where the briefing with the President was. Unfortunately, the driver of the car got lost. It's only three miles from the airport down to the plant. If you drive along the river, it's hard to miss the plant. It's got those cooling towers and all. But anyhow, he got lost. And it took Roger an hour to get from the airport to the plant. And by the time he got there, Hendrie and Stello had pretty much

concluded that the bubble was not a problem. And Roger, once he heard their arguments and their conclusions, agreed. So that pretty much ended the bubble issue. It pretty much ended the crisis at Three Mile Island. After that, there was still a lot of uncertainty, there was still a lot of anxiety. But the level of anxiety and the level of concern at least was lowered a great deal.

So the end of the crisis at Three Mile Island came then on Sunday afternoon after five very harrowing days. And the end of the crisis also marked the beginning of a long term effort to make certain that TMI or something like it did not happen again. And I'm going to turn the lectern back over to Chairman Diaz. Thank you

Chairman Nils Diaz: Thank you, Sam. We appreciate your perspective and your insights. I noticed at times there was a little bit of personal involvement in some of the characterizations that you made, which makes it good. We now are going to start the second part of the program in which me as Chairman of the NRC and my two fellow Commissioners will discuss some of the developments in the agency after the accident and especially in terms of

regulatory improvements, improvements in specific areas that, of course, were highlighted by the accident.

You know, I guess I have to go first. I almost wanted to go last, but I'll try to go first. Let me just step away from some of these brief remarks and bring out a personal note to it. Of course, I was alive when TMI happened. Some of you that know how young I am might wonder about that. But I was alive. I was a young assistant professor of nuclear engineering. Actually no, I had just been promoted the month before to full professor. I was assistant professor when I went to B & W. And I actually got trained as senior reactor operator in the B & W systems. And I always called the B & W plants racing an Arabian horse, because they had fast steam generators, super heated water. And I used to call the Westinghouse Combustion Engineering a plowing horse, you know, very strong, very massive, lots of water, lots of good things. But I was in my office the day of TMI. And of course everybody knew that I was B & W trained. So we actually kept a watch. You know, kept plotting what things were happening. And unfortunately, I cannot describe the language that was

used at times in that place, but it was very very strong English language. In fact, I probably learned a few words that day.

Among the important revelations of the TMI-2 accident investigations, including the two major reports, both the Rogovin reports and the Kemeny reports, were really a set of related issues. It was either real or many times perceived perception of complacency about the safety of plant operations, the absence of serious attention to human factors, personnel who were trained and handling routine operational events but not quite well prepared to respond to accident conditions. And there was the isolation of top management from the details of day-to-day organizational activities, including safety related activities. I'm talking about 1979.

Taking all together, these issues pointed to what was then called human factor considerations. Today we have broader terms, terms that actually started, you know, after the Chernobyl accident. Today we call them the absence of well developed organizational safety culture. Or I prefer to call them organizational safety

management.

These observations about human factors, at that time, were applied both to the NRC and the industry. Right after the accident, the NRC took several steps to address safety management concerns within the NRC and within the nuclear energy.

Soon after the accident, the agency created the Office of Analysis and Evaluations of Operating Data, AEOD, to provide the NRC better information about plant safety, performance trends, and identify accident precursors. It also implemented management changes, contained in Reorganization Plan Number 1 of 1980, which sought to define more clearly the role of the Chairman, particularly during emergencies.

You might have guessed, inferred, or know from what Sam was saying that there were issues on who was in charge, how orders were given or how they were related. And I think everybody was very concerned about this. So the Reorganization Act came to be.

NRC also sought to consolidate its more than eleven headquarter sites in the Washington area to bring the Commission and the NRC staff into a single location, an

outcome that was finally realized in 1988 when we moved to these buildings in the White Flint complex.

At the same time, the NRC performed a comprehensive review of its safety requirements and enhanced its emphasis on human factors and the use of simulators in its own training programs and by utility management in their training exercises. It was obvious that there was not an adequate amount of training for the operators when TMI happened. I used to, you know, comment -- over the years when I used to teach, that there was something very obvious that existed in TMI which was superheated steam. And nobody seemed to realize that fact.

The NRC also focused some attention to safety management by licensees at the individual plant sites, but recognized that they have no particular expertise in this field and that the responsibility for plant management, as it was and as it is now, rests in the hands of the industry itself. And it was the industry that needed to go forth and improve safety management.

Industry, shortly after the accident, created INPO, which represented a pooling of industry expertise in a

single organization with industry-wide authority. INPO was to establish benchmarks for excellence in the management and operation of nuclear power plants and to conduct independent evaluations to determine that the benchmarks were being met among other things. INPO became a primary mechanism for improving safety management or safety culture in the industry, with a special emphasis on the training of operators and personnel. And it's still going strong today.

In talking a little bit about safety management. Extended shutdowns at nuclear power plants, such as Main Yankee and Milestone in the 1990's, then D.C. Cook and later Davis-Besse in 2002 periodically raised NRC and industry concerns about whether organizational cultures with a strong sense of safety management have been successfully maintained. This is an area that I think we all care a lot about.

In a recent address to INPO, I outlined my views on the importance of "safety management", using a term, you know, a term that I prefer to say to "safety culture" because of its greater specificity. In my view, safety management embodies the desire to do things right, a questioning

attitude, a willingness to learn, and the awareness of how indispensable safety is. And it consists of three interactive elements. Number one, a functional and executable commitment to operational maintenance and engineering safety embedded in every activity of the organization. Second, a technical expertise that is applied where and when it should be: able to receive, process, form, and communicate technical issues cognizant of safety functions and of safety systems with licensing and regulation as boundary conditions but taken beyond them by the pursuit of safety and reliability. And last, the people, programs, and processes to implement a safety program effectively.

Safety management remains the ultimate responsibility of licensees. The NRC's keenly interested in the result licensees achieve in this areas. And NRC's role is to help the industry continue to sharpen their edges on safety management. It is a task that requires continual vigilance now and in the future.

Another topic that is one on my favorite list deals with emergency preparedness. With respect to emergency

preparedness, the TMI accident brought increased attention to deficiencies in planning for nuclear accidents, when the state of Pennsylvania had to scramble as the TMI accident was taking place, to create an emergency evacuation plan for citizens living outside a five mile zone surrounding the plant, in the event general evacuations were ordered beyond the five mile zone.

Prior to TMI, the NRC, like its predecessor agency, had relied on siting requirements and a small two to three mile exclusion zone to protect the public. However, during the late 1970's, questions were beginning to be asked about emergency planning. An NRC/EPA Task Force in 1978 had recommended the creation of an emergency planning zone consisting of plume exposure pathways for about ten miles from the plant and ingestion exposure pathways of a radius of 50 miles.

Shortly thereafter, during the midst of the TMI crisis, GAO issued a report calling for improvements in emergency planning. After the accident, Congress focused very critical attention on emergency preparedness, and in May 1979 conducted hearings for

three days -- we haven't had a hearing for three days in a long time, and we don't want any -- and in an amendment adding to NRC's fiscal year 1980 authorization bill that mandated stricter emergency planning requirements.

By August 1980, the NRC issued a final rule on emergency planning that included the emergency planning zone concept annunciated by the 1978 NRC/EPA task force. The rule also stipulated that NRC would not issue a new operating license without a satisfactory emergency plan and that existing plants have to develop an adequate plan by April, 1981. The NRC would base it's decision on the adequacy of these plans, based on the findings of FEMA, which had been created in 1978.

New emphasis on emergency preparedness has naturally arisen following the events of September 11, 2001. This has brought to our attention the need to integrate emergency preparedness with safety and security as part of our defense-in-depth approach to safeguarding public health and safety. To this end, we have recently created a new project office in NRR to consolidate emergency preparedness activities and to increase

management attention in this area.

One more word for focusing on the value of emergency preparedness. EP is done as a necessary and sufficient component of the NRC and our licensee's activities to ensure adequate protection from radiological hazards. It is related to reactor safety and security by anchoring them at the vital interface of the public; the public's body, and the public's mind. It is also today an indispensable component of our obligation to earn and hopefully to ensure public confidence in the discharge of our mandate.

Both safety management and emergency preparedness represent areas that were addressed in the post TMI environment and require the licensee's management and the NRC attention. Both have been event driven, but probably should not have been. They are inextricably linked to the use of nuclear energy and to nuclear regulation in more than one way. Safety is, and will be our vision, our goal, and the sum total of our objective. With that, I would like now to turn to Commissioner McGaffigan for his perspective on the post-TMI regulatory environment.

Commissioner Edward McGaffigan: Thank you, Mr. Chairman. I'm going to stay here and not use the podium. I think it's just more comfortable here. Thank you, Mr. Chairman, for a compelling discussion on the significant strides in safety management and emergency preparedness that have been accomplished by the NRC over the past 25 years.

I want to join the Chairman in complimenting Sam Walker, both for his presentation today and for his recently published history of the Three Mile Island event, which I believe is the single best discussion on the subject. I read it a month or two ago in galley, and I hope the typos all got fixed. But it is a very good book.

I'm going to depart from my formal remarks just briefly. Twenty-five years ago today I was in Russia. I had gone to the Soviet Union to serve in our embassy at Moscow from the summer of 1978 until April of 1980. During the Three Mile Island event we were at the end of a very long chain. There was no CNN in those days. There was great interest, particularly at the Ministry of Power and Electrification, in what was going on at Three Mile

Island.

There was a deputy minister there who was the chief nuclear person. I forget his first name. His last name was Ovchinnikov. A very fine Russian patriot who had grown up in the nuclear power industry and was an advocate for safety. They did not have a regulator. But he was, in my impression, the person who advocated for things like containment structures.

The folks at a competing ministry -- the State Committee for the Utilization of Atomic Energy, which was akin to our old Atomic Energy Commission, both in the weapons business and in the research business, headed by a fellow named A. M. Petrosyants-- tended to view containments as a needless luxury of pampered capitalists.

I remember that when we received the Kemeny Commission Report, we got it quickly to the Russians and they translated it. Governor Bruce Babbitt of Arizona, who served on that commission, came to Moscow in late fall of 1979. And there were extensive discussions between him (he's not a technical expert, he would be the first to tell you) and those two ministries about what his insights were from the

Kemeny Commission report.

Clearly people like Ovchinnikov were not fully heeded in the Russian system. There was a great deal of hubris and complacency that, even post-TMI, clearly contributed to the sorry chapter in their history at Chernobyl seven years later.

Let me go back to my talk now, having given you a little bit of background of where I was 25 years ago. The theme that you'll see running through our talks today is that the NRC and the industry it regulates must avoid the complacency that contributed to the TMI accident now and in the future. And we must be dedicated to the continual improvement in our programs.

I'm going to focus in the area of control room operations and the advances that have been achieved there over the past 25 years. I should note at the outset that improvements I will discuss were not made by NRC alone but often in partnership with the key institution that Chairman Diaz mentioned that industry itself formed in the wake of the TMI accident, namely the Institute of Nuclear Power Operations, INPO. The Kemeny Commission had strongly recommended that the

nuclear industry set and police its own set of standards of excellence. In response, INPO was created and, from its very inception, has had as its central focus the pursuit of operating excellence as a goal for all of its members.

In operator training, the NRC has often been able to rely on INPO initiatives, including INPO certification of licensee operator training programs, although we continue to inspect licensee operator training programs on a sampling basis and to administer operator license exams. The INPO/NRC relationship has been a fruitful partnership, for both parties.

Perhaps the most significant improvements in control room operations today, compared to the TMI accident, are in the procedures that operators turn to and follow when an event occurs. The procedures in place 25 years ago provided careful, detailed, and technically sound methods to mitigate accidents and transients. One major weakness, however, was that operators often were required to correctly identify the accident while it was in progress in order to know which of the many procedures would be best to use. To

accomplish this, operators were provided with a great many instruments, gauges, dials, lights, and alarms. NRC required then, and still does, that all plants be conservatively designed and robustly constructed with great defense-in-depth. This was done precisely to ensure that the control room operators would have ample time to survey their indications, to diagnose ongoing events, and then to implement effective mitigative strategies.

The plant was rugged enough to remain safe for some time while operators decided what to do. Nonetheless, human error was hardly impossible amid so many signals, lights, sounds, and displays. And that's what happened at TMI 25 years ago, human error where operators misinterpreted certain indications and turned off safety equipment that was keeping the plant safe.

The difference today is that simply by following the symptom-based procedures now in place, operators will mitigate the event without the need to fully understand it or to identify its exact cause. Their actions are directed in response to displayed symptoms rather than following a diagnosis made under stressful

conditions that they would surely face in an accident and did face at TMI.

Another very important development involves the extensive use of power plant control room simulators. Before 1979 a lot of training involved walk-throughs with operator candidates explaining to their trainers just what they were doing, what they were looking for, et cetera. Those who were administering tests to candidate operators had to do the same thing, informing candidates of what the gauges displayed theoretically, what the alarms were sounding theoretically, et cetera. Advances in information technology since TMI have allowed NRC to mandate that plants acquire advanced computer-driven simulators that faithfully duplicate their own plant control rooms right down to the location of individual switches on the panels.

It's not just that the simulators are convincingly real, though they are. More importantly they are of such scientific fidelity that postulated accident scenarios, including the one that occurred in TMI, can be accurately reproduced on them. Similarly, actions taken by operators can be tested and evaluated, both for

effectiveness and feasibility of implementation.

Operating shifts can now be evaluated as teams, including information flow and command and control. Evaluators and human factors specialists now witness how data and indications get interpreted, how knowledge is developed and communicated, and how decisions are made and implemented. In effect, reactor operators get their training on accurate simulators, just like military and civilian airline pilots or NASA astronauts.

In summary, operators are now trained, tested, and periodically exercised under conditions that are virtually identical. We can't replicate the stress, but we can replicate everything else to what they would experience in a natural control room event.

They and the testers grading them get to see, to hear, to virtually experience the accident scenarios in real-time. The result has been a tremendous upgrade in the quality and quantity of operator training and the ability of evaluators to properly assess operator performance.

The third area of improvement in control room operations I would like to mention does not really

involve the control room at all. In fact, the importance is in what the control room operators do not have to do today. After TMI, NRC mandated that the plants establish two additional facilities, separate and removed from the control room; the Technical Support Center, or TSC, and the Emergency Operations Facility, or EOF. After the onset of an accident, these two facilities are promptly manned by senior support staff and are provided with instruments and monitoring capability apart from the control room. The personnel at these facilities take over tasks and responsibilities that otherwise would fall on the shoulders of those in the control room and did in fact fall on the control room shoulders in the TMI event. These tasks include obtaining additional outside resources of manpower, such as engineering and repair teams, and participating in off-site emergency planning decisions, including interfacing with state governors and the media.

By staffing the TSC and the EOF with personnel specifically trained in those communications duties, those tasks are placed in the hands of individuals for whom that is their main job while lightening the load of

control room operators whose attention should remain focused on operating the plant safety systems to best mitigate the accident.

There are many other improvements that I can mention as well. I'll name just three without going into the detail I did on the first three. The creation of the shift technical advisor ensured that a degree of theoretical scientific knowledge was always available to operators on a 24 hour a day basis. Instrumentation and human factors improvements in the control room made the operators' jobs easier during accidents. And guidance was issued limiting overtime to assure that operators would -- this is in the early 1980's -- to assure that operators would not be handicapped by fatigue if an accident did occur.

We take our responsibilities in this area very seriously. Much of our focus at Davis-Besse in recent months has been on the assessment of operations and operator preparedness to resume power operations. Part of the draft confirmatory order proposed last week by the NRC staff requires an independent assessment of operations annually, through 2009, along with three

other areas. Through our oversight processes and these independent assessments of operations, safety culture, corrective actions, and engineering, we will ensure that there is no complacency at Davis-Besse going forward. And I think our processes ensure that there's no complacency anywhere at NRC on a daily basis.

We have by no means reached the endpoint in our efforts to improve control room operations. The on-going revolution in information technology will surely give us new tools to exploit going forward, both for the existing generation of reactors, and especially for future generations of power reactors.

Let me now turn the program over to Commissioner Merrifield who will focus on the enormous improvements in communication capabilities available to us today compared to 25 years ago.

Commissioner Jeffrey Merrifield: Thank you very much, Commissioner McGaffigan. My fellow Commissioners departed, at the beginning of their presentations, on what they were doing on that fateful day in 1979. For my part, I was a sophomore in high school so I was at a little bit of a different viewpoint. The biggest

concern for me at that point in March was the driver's education course that I was taking. And for those of you who have been to the rural part of New Hampshire where I'm from, getting a driver's license is a big deal.

I'm going to talk in my presentation about the communications initiatives that have been undertaken in the 25 years since then. I do want to note -- and both Commissioner McGaffigan and Chairman Diaz have mentioned it -- what a terrific job Sam has done on his work that he is presenting to us. I was a history major among other things in college. And I am particularly impressed by the work Sam has done. From my standpoint, it really, as painful as part of that book was to read, I think it is a real lesson for Commissions, for Commissioners in the future, and for virtually all of our staff who come into this agency. There is no better way of capturing where we shouldn't be than reading about where we were.

The NRC's communication capabilities are vastly improved since the TMI accident. Utilizing the lessons that we learned from TMI, the agency has made a strong

and a deliberate effort to improve the way that it communicates. Additionally, technological advances in the last 25 years have further enhanced our efforts in this regard. The federal government as a whole has embarked on initiatives to improve communications during times of crisis. The one-voice initiative is a government-wide effort to coordinate the communication of all federal agencies responding to an emergency so that the federal government speaks in a consistent manner, following a radiological event. Both internal and external communication efforts are in part aimed at avoiding the wide ranging assurances and unduly optimistic predictions that brought into question the NRC's credibility during the TMI crisis.

As Sam Walker has just explained, many of the communication failures during the TMI crisis resulted from the lack of an effective command and control structure at the NRC. To address these issues, Congress approved reorganization of the NRC to make it clear that in times of emergency, the Chairman is in charge. The other Commissioners are kept fully informed of the crisis as it unfolds, but the Chairman need not consult

with the other Commissioners when decisions need to be made on an immediate basis. This has the advantage of allowing for more streamlined and expedited decision making during a crisis.

As Sam explained, in 1979 the Commissioners were separated from their staff by ten miles. And this distance exacerbated the difficulty of communicating during an emergency. Today the Commission and all of the headquarters staff are located here in Rockville, Maryland at the White Flint Complex. This allows emergency teams to be assembled very quickly to coordinate an emergency response.

In the event of an emergency, an executive team, typically headed by the Chairman or a Commissioner acting as a Chairman is assembled at the NRC Operations Center, which is here in this building at White Flint Two, our command center in the event of a crisis. The Chairman is joined by the Executive Director of Operations and other senior managers, technical advisors, communication specialists, and public and congressional affairs liaisons. The Operations Center has several rooms where teams of experts in the agency

can analyze the data relevant to the crisis with state of the art technology, providing up-to-date information about the condition of the plant and information about the surrounding community. It has dedicated phone lines to the four NRC regions and all 103 nuclear power plants.

Consequently, communication with the plants effected states, and the public is better coordinated to reduce the possibility of conflicting or confusing information being disseminated, as was described by Sam previously. Even as we speak, however, further technology enhancements are being made to this important facility.

The NRC has developed checklists to ensure that appropriate federal and state agencies, Congress, and the public are informed as soon as possible and channels of communication are developed to ensure timely updates. After the events of September 11, 2001, the NRC greatly enhanced its ability to effectively communicate with other federal agencies the security functions, such as at the Department of Homeland Security, the Central Intelligence Agency, and the Federal Bureau of

Investigations.

During the TMI crisis, the NRC staff at headquarters had difficulty communicating with personnel at the plant. That problem has been addressed by installing phones in the central control room of each reactor with a dedicated line to the NRC Operations Center. More importantly, NRC resident inspectors are now located at every reactor site in the country. That arrangement gives the NRC its own eyes and ears in a crisis to assist the plant personnel addressing the problem. The resident inspector programs are managed by the four regional offices. And during a crisis, the regional offices who are closer to the plant and are familiar with the plant and officials in surrounding counties provide further support to the NRC's Operations Center.

When conditions warrant, the NRC will immediately dispatch a team of experts from the regional office, including the Regional Administrator, to join the resident inspectors at the site. When that team arrives, authority to respond to the event is transferred, including communications efforts, from the

headquarter's Operations Center to the Regional Administrator. This allows communications to be handled by an on-site team and furthers the NRC's ability to monitor conditions at the plant and to improve communications with headquarters, the affected states, and the public.

The Chairman talked about emergency planning and preparedness rules and functions. Communications capabilities are tested during regular emergency exercises. These exercises include testing physical notification systems, such as sirens, phone and radio transmission devices, and the roles and responsibilities of individuals in charge of making notifications.

When communication problems are experienced, they are quickly corrected. Consequently, the NRC remains assured of the effectiveness of the communications systems and those who operate them. Also the decision making capabilities, flow of information to and from the plant, communications with the states are tested. Unlike the situation that existed before TMI, all of the Commissioners and members of our senior staff participate in at least one major training exercise each

year.

Technology is continuing to change, especially in the area of wireless communication. These advances will continue to improve the NRC's and the plant's ability to communicate in a crisis. To prepare for the Y2K turnover a few years ago, satellite phones were installed at each plant in our resident offices. After 9-11, classified phones were installed in each resident's office. Technological advances in modeling plume dose dispersion allows us to more effectively determine and communicate risk to states and local communities.

There have also been efforts to address communication issues important to insuring the safe day-to-day operations of the plants. The very same valve malfunction that lead to the TMI Plant crisis had been experienced at another plant previously. But the information about the issue was not shared throughout industry. Consequently, TMI operators, having no information about a previous valve malfunction, made incorrect assumptions. Today the staff uses bulletins, guidance documents, letters, and other less formal face-to face interactions to share staff and industry

insights.

While we are not perfect in this regard -- and Davis-Besse being an example of this -- we are continuing to make efforts to enhance our effectiveness in this area. If I could leave you with the one message, it would be that the NRC communications capabilities are significantly better than they were in 1979, and they are continuing to improve. Communications is vital to public confidence and ensuring that we can carry out our regulatory mission to protect public health and safety. We will continue to routinely test and seek to improve our communications capabilities in the future.

Before turning over the program to our Executive Director of Operations, Bill Travers, I again want to join Chairman Diaz and Commissioner McGaffigan on congratulating Samuel Walker for writing a terrific book. It is vital that we learn from the experiences of the past. Sam's good work will help ensure that the important lessons from TMI will not be forgotten. Now, it's my pleasure to turn the discussion over to Bill Travers who will discuss some of his personal

observations and insights regarding TMI.

Dr. William Travers: Thanks very much, Commissioner Merrifield. I'll compliment Sam at the front end of my presentation. I agree, it's a great book, a terrific primer for anyone who isn't very familiar with the accident, infinitely superior to the History Channel in my estimation. And I actually learned something new. I'll tell you what that is later, Sam, but I really did learn something new. I didn't think I would, but I did, and I appreciate that very much.

It really is hard to believe that the TMI accident happened nearly 25 years ago. And probably one of the reasons for that being so surprising is that it's surprising to realize that I've been working for the NRC for the past 27 years. I would like to be able to tell Commissioner Merrifield and Commissioner McGaffigan and the Chairman how difficult it was to get the job while I was still in junior high but that would be wrong. That would be so wrong, so I won't do it. But I did join the agency about two years before the accident. And at the time of the accident we really had no clue, but just

about everything we were doing in our regulatory programs for nuclear power plants was about to change dramatically. So I would like to give you a little bit of a vantage from someone who's career at the NRC and the technical staff has spanned these past 25 years.

Personally, the impact of Three Mile Island on me was that it resulted in my spending just under four years at the TMI site, about four years just following the accident beginning in the first week of April or so, not during the heat of the combat that was discussed earlier by Sam. But just after that, I joined the on-site crew. I spent about four months, through the summer of '79 and returned in 1984 to spend about three and a half years as director of NRC's clean up oversight effort.

I have to tell you one anecdote, departing a little bit. Everyone knows today, I think, that the Chairman is the spokesperson for our agency. And I've told this story to a few people, but never in a broad group. It turns out that on the morning of March 28, 1979, while I was working away in the Phillips Building on the staff of the NRR crew, I almost inadvertently became the spokesperson on the accident at Three Mile Island. And that happened as a function of a friend of mine who had

visited from Harrisburg the weekend prior who happened to work for a radio program, a radio show. And on the morning of 1979, even in advance of us receiving the word by intercom of what was happening at Harrisburg or TMI, I got a call from this fellow. And he asked me, What's going on at Three Mile Island? And before I could answer it, his boss grabbed the phone and said, we're going live and we want you to describe the events that are on-going at Three Mile Island. My jaws, as you might imagine -- you know, a two year staffer -- just about hit the desk. Needless to say, I explained to him politely that if he did so we would both probably look very foolish because I didn't know what he was talking about. But it was a memorable event.

From my personal perspective, the TMI-2 accident was a real low point for our agency, even though the accident did not result in significant radiological releases, even though the defense in-depth design of the plant worked to protect public health and safety, we at the NRC knew and the general public certainly believed that the accident should never have happened. We found that the NRC was not well prepared to respond effectively to an

accident. And many of us knew long before any studies on psychological stress that many people near Harrisburg had suffered a great deal of anxiety as a result of the accident. There was a real sense of shock at the NRC that something so significant could have gone wrong. And it really was a gut-wrenching time.

Much has been said about the mindset of the industry and the NRC at the time. And as members of the Commission have noted today, there was many failings, in part due to overconfidence in operations, assumptions about operator performance and training, perceived invulnerability of plants to severe accidents, and an inability to effectively communicate on previous operating experience and other important issues.

NRC was perceived as part of the problem. And it didn't feel good. In the face of this -- of course the good news has been pointed out already by the Commission -- that the NRC determined that it would learn from the TMI experience. And we've done exactly that. We've been actively applying those lessons into our much improved regulatory programs ever since. And hopefully today's program will help reinforce those lessons for all of us, particularly those of us at NRC. In the

months immediately following the accident, as a member, of NRC's on-site team, I was struck by both the enormity and the dedication of the response. More than a thousand people or so descended on TMI to ensure long-term stability of the reactor, to determine exactly what happened, and to begin planning for the clean up.

It was an amazing time. TMI had national priority. If equipment or engineering talent was needed, it was delivered quickly. An example of this was an Air Force C5A that was used to fly an entire air filtration system to Harrisburg from a canceled plant in Washington state. I remember having to avoid signing a receipt for those expenses. And I never did find out who actually paid for that one. Glad it wasn't me.

The first weeks and months after the accident, as you might imagine, went by very quickly. NRC had a fairly large number of staff at the site. And we were involved in the details of nearly every significant activity. Coverage was 24/7 and NRC approval was required for nearly all of the new post-accident procedures. Twelve to fourteen hour days were the norm. Our temporary trailers were not plush, but our energy

was high. We really knew this was important.

Back at NRC Headquarters, nearly everything that we had been doing in our power reactor program essentially stopped. Nuclear power plant licensing was halted as we participated and cooperated in accident investigations and undertook our own lessons learned efforts. Many of our key staff volunteered for and were actually moved to a new location in Bethesda to participate in the Regovin study.

Any NRC staff from that time in the audience, I'm sure, will remember the summer of 1979 as the summer of a missed summer vacation. But the staff, in my estimation, really rallied, and largely voluntarily, to the efforts that we undertook that summer.

This introspection by the agency and the independent assessments by the outside groups such as Kemeny and Pennsylvania's Governor Thornburgh, pointed out the need for a number of changes at the NRC. And I think that the Chairman and Commissioners McGaffigan and Merrifield have touched on many of the most important changes that NRC has made since the accident.

One change that was evident at the time was NRC's

enhanced, refocus really, on all aspects of operational safety. At the time of the accident, the largest fraction of our effort was nuclear power plant licensing. And most of us in NRR were almost exclusively involved in new plant licensing issues.

One of the most important actions that was taken to ensure a better focus on operational safety was the strengthening of our regional offices and the expansion of NRC's new resident inspector program. Many of our best employees were assigned to resident inspection sites to serve as the eyes and ears of the NRC and to provide direct oversight of our inspection, assessment, and enforcement programs. I think the experience and leadership developed during those field assignments have a long standing impact on the quality of NRC operations and programs. Some of the early resident inspectors now serve in some of NRC's top leadership positions, including Regional Administrators and headquarters senior management.

More broadly, the movement of personnel between headquarters and our regions, has enriched our regulatory process in all of our program areas. And importantly,

we continue to encourage this kind of experience at NRC. At the same time, the NRC began both the TMI specific investigations and our broader assessment of the accident's implications for all nuclear power plants. Some of us continued to focus on TMI itself.

Immediately after the accident, a number of significant challenges remained at TMI. Continued long-term cooling of the damaged core and clean up of significant quantities of highly contaminated water in both the reactor and the auxiliary buildings became top priorities. To carry out adequate oversight of these activities, NRC created a dedicated organization comprised of staff from both headquarters and Region I. The challenges for both the licensee and our oversight included decontaminating nearly a million gallons of highly contaminated water. The accident caused the reactor building to be flooded to about eight feet with water containing several hundred thousand curries of radioactive material.

Although the potential for leakage of this water was not great, the fact that so much radioactive material was in water in the reactor building basement

on an island in the middle of the Susquehanna river was very much on our minds.

Another early challenge was the fact that essentially all of the auxiliary and reactor building surfaces were fairly highly contaminated. And this required an exhaustive campaign using new techniques, including robotics, to reduce worker dose for the activities to follow. Strippable coatings, routinely being used today as a result of the TMI accident, would have been a distinct advantage at that time. But the most significance challenge at TMI, of course, was the removal of the damaged fuel.

I should point out that, outside in the lobby, if you're interested in seeing what $t-_0$ (time = 0) looked like when the operations for defueling the reactor began, there's a couple of posters that Jim Burn, who was on the licensee staff during the years of clean-up, brought. You can get a really good idea of what they faced.

Fuel removal required a development and use of a unique system to cope with TMI's damaged core, including a drilling rig installed on the top of the reactor vessel to break up parts of the core that had been

molten during the accident. This effort took several years, I think eight in total. But most of the fuel, expect for about 900 kilograms or so, was removed, placed into special containers, and shipped to INEEL for storage. That's Idaho National Engineering Environmental Laboratory. Importantly, prior to its removal, the conditions of the post-accident TMI-2 core were mapped in detail. This information has been significant to our understanding of severe action progression.

I should note that a fundamental element of our NRC clean-up oversight program was our on-going communication with the public. We didn't have the Internet at that time, but a key element in our communication strategy was the creation of an independent advisory panel made up of local citizens, locally elected officials, and local scientists. In fact, one of local scientists was a Penn State professor by the name of Joe Palladino, who later became Chairman of the NRC.

Important information was discussed with the advisory panel in evening sessions in public. I think

this did a lot to provide information throughout the course of those years that was helpful in understanding the pace and the precautions that were being taken by both the licensee and the NRC staff. In fact, this approach of creating an advisory panel has been copied during other large decommissioning projects since TMI-2.

I could mention a host of other TMI experiences and some more specific improvements that we've made since the accident, but I think I'll close by reinforcing the Commission's view that the NRC has indeed made significant improvements in many key areas since TMI. From that low point, we've traveled a long and sometimes rugged road, and we know that there is really no room for complacency here. I think it's clear that the seeds of change brought on by the accident still live with us today. And our commitment to our safety mission and to the objective of continuous improvement is stronger than ever. Thank you.

Chairman Nils Diaz: Thank you, very much, Bill. Thank you to all of our panelists and fellow Commissioners, Sam and Bill for their presentations. We

now convene really as a panel to be able to start taking questions from the audience. You've been on the receiving end. We have microphones set up so that you can get ready to ask your question. I must say that to be provided a historical perspective, as an under aged professor, I needed a special dispensation to sign papers at the time. I was just competing with Commissioner Merrifield.

But please state your name and direct the questions to whoever you want.

Ms. Diane D'Arrigo: My name is Diane D'Arrigo, and I'm with the Nuclear Information and Resource Service. There was an estimate made of the radiation that was released from Three Mile Island. And it's my understanding that that estimate was made and what the doses might have been to the surrounding community, the people downwind, that estimate was made prior to the knowledge that there had been a partial meltdown of the fuel. Then after it was realized that there was actual core melt, I understand that changes were made in the calculations of what went on within the reactor but there had never been any reassessments of the exposures

to the community outside.

Chairman Nils Diaz: I don't know that the process did not continue. Maybe Bill knows. But fundamentally, I think that the doses were assessed at different times and that there was significant efforts made to make sure that the doses represented what the people did. But I'll let Bill answer that.

Dr. William Travers: I think there have been exhaustive studies to ascertain, somewhat by projection, just how much radioactive material was released. But I don't think that there was any view that the knowledge of what was existent in the reactor core when they finally got the reactor vessel head off and took a look was vital to the knowledge base needed to make those estimates. So I think that there's fair agreement that the estimates that are on the record, as far as the amount of radioactive material released during the accident, are good and sound estimates. Again, they did not rise to the level of being viewed as causing serious radiological consequence.

Ms. Diane D'Arrigo: My question is specifically, if there were reassessments of the doses to the public

and the releases made from the reactor after the knowledge that there was a core melt.

Dr. William Travers: I don't know the answer, specifically to that. But I would say almost certainly that, if there was a view that that information had great bearing on those estimates, that that would have been undertaken. To my knowledge, the estimates that have been made at radiological releases have been consistently evaluated within certain margins.

Chairman Nils Diaz: I do believe that because of the concern with the populations and the issues that were raised including amounts of mitigations, that efforts were made to assess the doses to people. And that's what really, I think, the focus of the efforts were, is making sure that the dose to the populations or people exposed, were properly tracked. And in that respect I think that significant efforts were made to have those doses, you know, really pinned down as good as possible.

Commissioner Jeffrey Merrifield: It might be helpful at this point, for the purposes of a full record -- I don't know whether Bill Travers or maybe Sam could

talk to this. But there were a significant number of studies undertaken after the Three Mile Island period where 18,000 people were tracked in one of the studies. Maybe we can speak a little bit to that because that's real data that has been taken as real fact.

Dr. William Travers: The first thing I'll mention is that the estimates of releases were based on measurements that were actually taken at the time --

Ms. Diane D'Arrigo: But the monitors went off scale.

Dr. William Travers: -- and sampling in the environment as well. Following that, if I'm right, Commissioner Merrifield, as a result, is relating or indicating that there had been follow-up health studies that had occurred in the area of Three Mile Island, some of them sponsored by the federal government, I believe, that have occurred. And all of those are in fair alignment to suggest that, number one, we have a good base for depicting the releases that actually occurred during Three Mile Island, even if there is some degree of margin on either side of what the specific releases have been estimated to be; and number two, that the

radiological releases that occurred were small enough that there has been no statistically discernible impact on the population surrounding Three Mile Island.

That has been contested by others, but I think the generally held view is that the most significant studies have confirmed that over and over again. I think there have been two or three of them. I can't recall the names at the moment.

Ms. Diane D'Arrigo: It's my understanding that those studies were prohibited expressly from considering doses higher than those calculated prior to the knowledge that the core melted.

Chairman Diaz: I can't comment on that.

Ms. Diane D'Arrigo: Well, it's an important point for the public. The fact that the estimates that we're operating on were before we even knew that the core melted, and that the amount of radioactivity -- monitors didn't work, monitors went off scale, and that the estimates that are currently the operable ones were done prior to the melt. And if there's information to the -- contradicting this, that's what I'm asking for. And I would like to see it.

Dr. Samuel J. Walker: I would like to make a comment as a historian. And this whole thing about the monitors going off scale, there was one stack monitor that went off scale and it went off scale because it was calibrated at a very low level. There were 20 monitors placed there before the accident in accordance with the NRC regulations. And they didn't go off scale. The one that went of scale, the fact that it did not mean a whole lot in terms of what was --

Chairman Nils Diaz: Dose assessments were properly done. But I think -- Carl Paperiello?

Mr. Carl Paperiello: I think I can provide some information because I spent about a month at Three Mile Island right after the accident, overseeing all of the environmental measurements that were made. There is a NUREG that came out -- I don't remember the number, several years after the accident, which compiles the data and derives the population dose estimates. There were thermal luminescent dosimeters around Three Mile Island before the accident. There were air monitors for both Iodine and particulate around Three Mile Island before the accident. They were pulled and changed out during the accident as

time went on.

So there were DOE arms flights over the area measuring dose. And all of that data was pulled together. What happened in the core is less important, because that stayed in the reactor, than what got out. And the estimates were based upon the amount of material that was actually released, number one, and the actual dose measurements that were made in the environs around the plant. And they were integrated doses based on thermal luminescent dosimeters. But all that information is documented in the NUREG. Thank you.

Chairman Nils Diaz: Thank you. I appreciate it. I also believe that three of our regions on the TTC are on. So if there are any questions from the staff or any other members of the staff in here, the public that is attending, please go to the microphone.

Mr. Meraj Rahimi: My name is Meraj Rahimi. I'm with NMSS Spent Fuel Project Office. I want to thank you for the panel discussion. It was very informative. Twenty-five years ago I was a sophomore at the University of Tennessee studying nuclear engineering, taking reactor dynamic courses. And I wanted to be a

reactor operator, which we went on, some of my classmates went on to graduate school, changed majors, and went to computer science. But I stayed with nuclear engineering, which I'm glad I did.

The one question I have, if there was no indication for the water level in the core, why did the operator decide to cut off the pumps? You know, why did they think, you know, the pressurizer was going solid? Is that some teaching from the Navy?

Chairman Nils Diaz: It's a nuclear Navy thing. The pressurizer cannot go solid because the sub goes down. They have no control over it. And so that was the immediate reaction, a pressurizer cannot go solid because then you have no way to control the power, the sub goes down. So, you know, it was difficult for the island to go down. But anyway, they acted the same way. That was it really. It was ingrained in every operator, you don't allow the pressurizer to go solid, so you try to keep the water level from rising in the pressurizer, and that's it. It's fundamentally a mistake.

Mr. Meraj Rahimi: Thank you.

Chairman Nils Diaz: And of course when you have a pressurized water

reactor, you know, I always keep telling people that that means you pressurize the reactor, don't depressurize the reactor, which is the other issue. Yes, sir?

Mr. Paul Gunter: Hi, my name is Paul Gunter. I'm with the Nuclear Information Resource Service. A quick comment. It's my understanding that those 20 dosimeters, those TLD's that were around the plant left some very wide open windows as well which a plume could have moved without detection. And that remains a concern today. And I think that was part of the follow up action that NRC took to realize that there needed to be more extensive monitoring established around plants to compensate for that inadequacy. But I think I would like to follow up on a question with regard to Chairman Diaz's comments that emergency planning has taken a much more important role in planning around nuclear power plants and even in the licensing arena. The concern is that the lessons that were learned following the Three Mile Island accident and emergency planning -- there are a whole host of areas but if I could just focus on one, and that is the

area of role abandonment, role conflict and role abandonment. I think that what the TMI accident demonstrated was that human behavior and radiological events are quite unique and unique to any other disaster in terms of both planning and in response. And what we saw in a number of studies, Professor Donald Ziegler publishing several, was that, for example, hospitals, out to 25 miles from Harrisburg and Three Mile Island experienced emergency room personnel doctors, nurses, medical technicians, abandoning duty. And as well closer in, but as far out as 25 miles.

Currently, the reception zones to receive evacuation evacuees from the power plant sites are typically within 20 miles. So one concern that I think that the lessons of Three Mile Island should address in the current emergency planning scenarios are that quite likely, under the current scenarios with the lessons learned, that evacuees from the ten-mile EPZ are going to be arriving to spontaneous evacuations which is only going to complicate, confuse, and confound effective evacuation. And I would like the Commission to respond to their sense of what has been done with regard to

current planning, given the lessons that we learned from Three Mile Island.

Chairman Nils Diaz: Sure. Thank you for the question. There is no doubt that spontaneous evacuation is a serious consideration in any type of evacuation. I think what we have done -- and I believe this is the case, is that people that actually work on this emergency preparedness and evacuation plans are much better prepared. For example, people that work in these areas realize that you're not going to die from sniffing radiation like you could with some other type of poisons where time is a factor, and distance, and shielding, and all of those good things that we learn in first grade are important. We do continue to work with FEMA and with our licensees in analyzing the potential effects of people trying to leave, or the instantaneous evacuation issue is always considered when we are looking at the time to implement the evacuations. I don't see that that is an issue that has been forgotten. On the contrary, I think it's pretty much on the forefront because it was something that did happen and we have learned from it.

I don't know if my fellow Commissioners, Bill, or Sam wants to add something to that.

Mr. Paul Gunter: If I could just be very specific though, what is now being incorporated into emergency planning to compensate for role conflict, role abandonment, and spontaneous evacuation?

Commissioner Edward McGaffigan: I'll take a try at it. I think in all honesty that one way to combat that is to get people in those hospitals, if people are going to abandon their hospital positions, good information about the effects of radiation. The notion that a millirem will hurt you, or a few millirems will hurt you is utter nonsense, or else we would, as a society, be taking very different actions to prohibit people from getting millirems.

I did a back-of-the-envelope calculation here as I was listening to some of the commentary. If we have a hundred million people who live in brick or adobe homes in this country, one third of our population -- just a guess, may get an extra 20 millirem per year as a result of that. When you apply the linear threshold model to that, we could say that thousands of

people died per year because they live in brick homes. I don't think that they do.

I think that what happens with radiation risk is that there's a dedicated group of people who want to hype the dangers of low levels of radiation, and they do a very good job of doing that. Indeed, I think that the Witt Report in New York criticized those groups for complicating response to radiological events, by putting out bad information, and getting people to do things that they shouldn't do.

We focused a lot, in the last year or two, about radiological dispersal device response. The Centers for Disease Control and other institutions in the U.S. Government have done a very good job, I think, of communicating with hospitals about how they would handle an RDD event. And I hope that that education effort will prevent in an RDD event, any sort of spontaneous or wrong evacuation of folks dealing with risks that don't exist.

But I think that radiation is different. I think that you're right, Paul, that radiation is different.

If we had an event with some phosgene gas or whatever on the railroad or a highway today, people would not react with spontaneous evacuation 20 miles away. If we had an event, any sort of radiological event, there's some possibility of that, unless we do a good job of communicating with the public what the real risks are. And unfortunately, some have megaphones who try to convey to the public information that is not correct with regard to the risks of radiation.

Commissioner Jeffrey Merrifield: I think there's two other comments I would make as well. I think, having listened to Sam's presentation and read the book, it's very clear that the communication breakdowns, in terms of what was available for information here in Bethesda and the way in which that was communicated by then Chairman Hendrie, was a result and cause of much of the public panic that was exhibited around Three Mile Island. People were taking their signals from a Chairman who wasn't really certain of what was going on and concluded for themselves that perhaps they aught to do something on their own.

I think that today one of the things that we have

done -- and we're working on this to provide this publicly, but we've contracted to take a look at emergency evacuations and to find out, is there some notion of this high degree of individuals, either evacuating on their own, or alternatively, individuals who have a responsibility to man emergency stations, to be there, and to be prepared. In that report -- and it looks at literally hundreds of evacuations that have occurred over probably a 20 year time period, demonstrates that that's not true, that in fact people are more disciplined in terms of evacuating appropriately and people manning their stations as is required.

And there's no panacea. People do treat nuclear issues differently. But I think that with our ability to communicate better, to provide accurate, timely, balanced information, to have the conduit with the states, with the local governments, and others will hopefully put us in a much better position in terms of the kind of response we're going to get from the public and the individuals who need to be there to deal with the emergency.

Chairman Nils Diaz: And the reality is that what we're doing now is just making sure that in 2004 we have processes and information for 2004. So we're trying to bring the new knowledge in, although we are, you know, really assured that what we have done up until now is adequate protection. We just want to make sure that we make it even better, if that is possible, or at least satisfy the requirements that we are up to state of the art in whatever we do. Yes ma'am?

Ms. Laura Jakes Jordan: I'm Laura Jakes Jordan. I'm with the Associated Press. Just a basic question. Can you all tell me when the operating license for TMI-1 expires? And can you give us just a general overview of the entire TMI facility?

Dr. William Travers: I can tell you after this meeting. I don't know it off the top of my head.

Commissioner Edward McGaffigan: It's around 2013, I believe.

Chairman Nils Diaz: It was 1977 or 1976, some place around there, because TMI-2 had just started a few months before.

Dr. Samuel Walker: 1973, I think, was when TMI-1 began operation.

Commissioner Edward McGaffigan: 2013 is when the

license expires, is my recollection. And we have not heard from the licensee whether they're going to be an applicant for a license renewal at this point. Does that answer your question?

Ms. Laura Jakes Jordan: (Inaudible.)

Chairman Nils Diaz: I think TMI-1 continues to operate well. They have not, like Commissioner McGaffigan said, they have not said whether they are going to go for the license renewal. They might have to do that decision relatively quickly. There is no other indications of any additional problems.

TMI-2 continues to be sitting by the side of TIM-1 and it's not going away. But fundamentally, we have not heard from the licensee regarding this.

Commissioner Edward McGaffigan: You know, on our web page there is a very good discussion for every plant of where they stand within the reactor oversight process. There are performance indicators in a variety of areas that you can look at. And my recollection is that TMI has a pretty green board at the current time. But the specifics of our inspection findings and the performance indicators at the site, as for every other

site in the United States, are available on our web page and are updated every three months.

Dr. William Travers: They include detailed inspection reports that are made publically available periodically as well. And we would be happy to help you.

Chairman Nils Diaz: Can I ask the regions if they have any questions? Pretty quiet bunch. Oh, I'm sorry?

Audience Participant: (Inaudiable.)

Chairman Nils Diaz: April 2014. Thank you.

Mr. Adam Wilson: Hi, my name is Adam Wilson. I'm with The Reading Eagle Newspaper up in Reading, Pennsylvania. Just a quick question. As power plants continue to age, is there an increased risk of another TMI style accident, albeit through a different scenario, occurring again?

Chairman Nils Diaz: We take the issues of plant aging very seriously. The fact is we have a continuing on-going evaluation of the safety of these plants. It's not done this year, this year, but there's a continuity of assessments of the safety of the plants. And so there is no indication from anything that we know

that there is an increased potential for an accident.

We have seen material degradation problems in some of these plants. Davis-Besse, there's been other areas where we've seen cracks in nozzles, which are normal typical aging of any industrial complex. What happens with nuclear power plants is that they have an additional level of inspection, additional level of oversight, both by the licensees, and by the NRC. So we tend to detect these issues very early, with the exception of Davis-Besse, of course. And now that we have, you know, put in place these programs of enhanced inspection of the primary coolant pressure boundary of all the grading components, I think we have added insurance that that will not be the case.

Okay? And I have the region -- do you want to ask a question? I think it's Region 1. Did we lose the audio? We have a communication problem.

Chairman Nils Diaz: We're going to take a couple of questions. We're going to have to adjourn in a few minutes.

Mr. Mike Masnik: Mike Masnik. Quick question, how do we get a copy of the book?

Dr. Samuel J. Walker: You've got three choices. You can go over to Borders. Borders has one copy in the gardening section. I check on that everyday when I'm over there. And you can pay full price for it. It does have my picture on the back, so it might be worth it. You can order it from Amazon which is selling it now for a 30% discount, so that's a better deal. If you're NRC staff, you can e-mail me, and I'll give you a copy for free. Three thousand copies. I should qualify that, while my supply lasts. I've got a good supply now. So if you want a copy, e-mail me at JSW, and I'll be glad, as long as I have copies, to send them out. That's why I write them.

Commissioner Jeffrey Merrifield: Sam didn't ask me to write an endorsement for his jacket cover. Had I gotten the galleys before hand, I would eagerly have done that. You know, I've had occasion to read quite a few books, to read history books about this arena that we're all in. And I have to say, I really do, I honestly do think he's done a terrific job of capturing what happened during a very difficult time period.

As a Commissioner, when I said it was painful, it

was painful to see what the Commission was going through at that point. It does not paint a pretty picture. Sam, I think, is very candid in the way in which he characterizes the significant gaps that we had as an agency. So it is very much for that reason that I do think, in our training programs, when we bring in new staff, I do think as part of that training program, we should require people to read that book because it really does capture how badly things can go wrong and how much we need to continue to strive to make sure that that does not happen again.

Chairman Nils Diaz: And by the way, every Commissioner trains at emergency response, they train as Acting Chairmen. And we take turns in going through the exercises. So every one of us have actually done this several times, and we continuously upgrade our knowledge in that area. There's one more question back there.

Mr. Mike Knapik: Mike Knapik from McGraw Hill. One of the lessons that was mentioned here this morning was a sense of complacency that existed at the time of the accident. Some industry leaders today, for instance, at

the World Association of Nuclear Operators, have also warned the industry about complacency today. Does the panel think that complacency is possible in the nuclear Industry today after the Three Mile Island accident and the 25 years since? And if so, you know, what steps do you think that the agency ought to be particularly vigilant in sort of watching to guard against that?

Chairman Nils Diaz: Let me take a quick crack at that. It should not be, but it definitely could be. We have seen a few cases that have lead to extended shut downs, both here and abroad. I think it is a fact that human nature sometimes relies on what I call prosperity. And that prosperity, in many ways, could lead to complacency. And we are very much aware of it. The agency continues to monitor the performance of licensees in a manner that allows us to make our assessments of adequate protection. I do believe that programs need to be systematically monitored and that the industry has a significant roll to play in this issue because we do not operate these plants. They do. Therefore, they have to actually be very concerned with the potential for complacency to creep in and to

actually cripple their operations. And of course, if it impacts on safety, I'm sure we will be there.

Commissioner Edward McGaffigan: Well, I would add that complacency clearly played a role at Davis-Besse. I think the licensee has said that itself. I think there was complacency at NRC that contributed to Davis-Besse in the sense that we were fighting other wars, we didn't have the right people there. You know, we've done a lessons learned. We weren't alone. INPO missed Davis-Besse too and have searched their soul as to why they missed Davis-Besse. And I think it put procedures in place to help their members better.

The industry has had and will, I hope, continue to have a very good run in terms of almost every performance indicator moving toward a good assessment in terms of performance. And I think that when you have a ten year run where things are constantly improving, there's a chance, I think, that you will start to get complacent. I think that Davis-Besse has ended the complacency for this institution, for INPO, and for the industry for some period of time in this country. And the challenge for us is to not need Davis-Besses to make

sure that there's no complacency anywhere. And I think we're up to that challenge. But Davis-Besse has been the evidence within this country, as the Chairman said, of a problem. And I think complacency has probably contributed to some problems abroad as well, which is why it was discussed at the WANO meeting.

But we are not going to be complacent. We don't need further reminders. And I think that we are dedicated in every one of these areas; emergency preparedness, control room operations, communications, et cetera, to making sure that we don't have these problems in the future. But that is something that has to be reinforced. And it's going to be reinforced through meetings such as this. And it's going to be institutionalized at this agency.

Commissioner Jeffrey Merrifield: You know, during the time I've had the privilege to be on the Commission, I've had the opportunity to go out and visit all of the operating plants, all 103 operating units. And I have spoken to hundreds of employees at probably 70 plus percent of those sites. And the issue of complacency

has been on the agenda of my discussion with those employees at each and every one of those discussions that I have had. It is very clear to me that that is one of the most significant things that we need to be taking a look at at any point during the course of what we do as an agency.

Using a rear-view mirror as a way of judging where you are right now is not always accurate. And as the mirrors sometimes says, things might be larger than they may seem in the mirror. And I think that's a good clue for the way we need to act.

For us as on agency, we have to do the same kind of thing. But I think one of the things that's is very positive about the approach that we take is that the training that we give our resident inspectors, our regional inspectors, and our headquarters based inspectors, demanding that they have a questioning attitude and to look beyond merely a set of performance indicators or a historic trend in performance, to say are there any other issues that we may not be aware of or are there any other indications that we may be seeing that would lead us to believe that things are not as good as they would appear at first

blush -- and I think that level of introspection on our part and a continued message from the senior management of this staff that we do want a questioning attitude, we want to continue to change our licensees, is a message that we have to stay on top of as an agency to make sure that we're fulfilling the public health and safety mission that's expected of us by Congress and the American people.

Chairman Nils Diaz: Dr. Travers would you like to comment on that?

Dr. William Travers: I couldn't agree more. The idea of complacency is one that is a constant challenge, I think, for any organization, particularly in an arena where the industry we regulate has been doing so well in the last ten or twelve years. If you look at safety performance by just about any measure, you'll see a remarkable change in last twelve years or so. So it is their challenge and our challenge to ensure that this factor -- and it's only one, of complacency, is one that is recognized and actively dealt with. I think it takes constant reinforcement.

Chairman Nils Diaz: And I think I'm going to close

this session by giving the last word to Dr. Sam Walker on an issue that I'm sure he dealt with intensely during the preparation of his book. Sam, last comment before we close this meeting?

Dr. Samuel J. Walker: Thank you all for coming. It's been a pleasure.

Chairman Nils Diaz: No, Sam. Come on.

Dr. Samuel J. Walker: I don't have a lot to add expect that the TMI was the most important event in our history and we learned a lot of lessons. Obviously, we need to keep relearning those lessons. That's why I'm very glad that we had this session. There were moments in the past couple of weeks when I wasn't so sure that I thought this was a good idea. But now that it's over with, I think it was a great idea. And I do appreciate the opportunity to talk about history.

Commissioner Jeffrey Merrifield: Mr. Chairman, may I put a few words in Sam's mouth. You know, we are very lucky as an agency that we have pursued the opportunity to have a resident historian. Some outside the agency, in government or elsewhere, might think that this is an unnecessary luxury. But I think that anyone who's read

Sam's book recognizes that this is a valuable investment in understanding our past and helping us to make a better future. So I'm very happy to be part of the process that continues to have Sam look at what we do and how we can improve it. So thank you, Sam.

Chairman Nils Diaz: With that, I want to thank every one of you on the panel and everyone of you that was with us today here and in the regions. And with that, we're adjourned.

[Applause].