U.S. CHEMICAL SAFETY AND HAZARD

INVESTIGATION BOARD

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BOARD OF INQUIRY

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MORTON SPECIALTY CHEMICAL
(ROHM AND HAAS) INCIDENT

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PUBLIC REVIEW OF FINDINGS

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Tuesday, July 18, 2000

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The Board met, pursuant to notice, at 9:00 a.m., at City Hall, 155 Market Street, Paterson, New Jersey, Dr. Andrea Kidd Taylor presiding.

BOARD MEMBERS PRESENT:

DR. ANDREA KIDD TAYLOR

DR. PAUL HILL

DR. GERALD POJE

CHRIS WARNER, ESQ.

C-O-N-T-E-N-T-S

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

(9:00 a.m.)

DR. TAYLOR: Good morning. We're going to get this meeting started.

I'd like to welcome everyone to this public meeting of the United States Chemical Safety and Hazard Investigation Board.

The subject of today's meeting is the 1998 accident of Morton International here in Paterson, New Jersey.

I am Dr. Andrea Taylor, and I will be chairing today's meeting on behalf of the Board. With me today on the podium are my fellow Board members: Dr. Paul Hill, to my left, your right; Dr. Gerald Poje; and our Chief Operating Officer and General Counsel, Mr. Chris Warner.

I would also like to acknowledge the presence in the audience of our fellow Board member, Dr. Irv Rosenthal. Dr. Rosenthal has recused himself from deliberating and voting on the Morton investigation due to his past association with Rohm and Haas, which has since acquired Morton International.

Today's meeting is an opportunity to witness the presentation of findings to Board members from the Board staff investigating the Morton case.

The Board will vote within the next several weeks to accept, modify, or reject the report of the staff.

Many of you are already familiar with the U.S. Chemical Safety Board. I will be brief in describing who we are and what we do.

We are an independent agency of the federal government authorized in the 1990 Clean Air Act amendments and funded by Congress in 1997. Our mandate is to investigate and report the causes of serious chemical accidents, accidents that cause deaths and injuries to workers, endanger the public, destroy property or damage the natural environment.

We have a maximum of five sitting Board members appointed by the President and a professional staff which includes investigators, lawyers, engineers, and support personnel.

The Board does not issue regulations or fines, and we do not find fault in our investigations. By law, the conclusions and recommendations of a Board report may not be used as evidence in civil liability litigation.

Our role is threefold. We investigate accidents thorough and ascertain their root causes. We report our findings to the public, the government, and the affected communities, and based on our findings, we make safety recommendations to government agencies, industry, trade associations, and others.

While exact statistics do not yet exist, we do know that chemical accidents are a serious problem in this nation. There are at least 100 serious chemical accidents at fixed facilities in the U.S. each year. Nationally chemical accidents result in around $1 billion worth of insured property losses each year. Total financial losses, insured and uninsured, are much higher.

The Board's overarching goal is prevention. We know that most chemical accidents are preventable, but in many cases people simply lack important knowledge about the causes of previous serious accidents.

The result, unfortunately, is that similar accidents recur unnecessarily.

We are gathered here this morning in Paterson to hear the findings of the CSB investigative staff regarding and serious chemical accident which occurred on April 8th, 1998, at the Morton International plant not far from where we sit here today.

The Board investigation of the Morton case has taken some 27 months to reach this closing phase.

The Board's goal for the future is to improve investigative process and issue reports much more quickly.

In the case of the Morton accident, the Board was only eight weeks old on the day of the accident and was operating with a skeleton staff of just five people.

The investigative process is complex and painstaking, and conclusions are never available as soon as any of us would like. The Board has made considerable progress in just the last few months recruiting additional skilled investigators. With our new staff, we will be able to increase the number of reports which are issued and also reduce the time required for their completion.

Today we will hear the findings of the Board investigation team which has been studying the Morton accident for the past two years. We will hear presentations from three staff: Mr. David Heller, the lead investigator; Mr. william Hoyle, the Board's head of Investigation and Safety Programs; and Mr. Richard Wedlich, a Board consultant with Chilworth Technology, Incorporated.

Board members will have an opportunity to question the staff at intervals during the presentation or at its conclusion. I will request Board members to direct their remarks strictly to the subject at hand, the Morton case, and to limit each question period to five minutes, and I'm going to be very strict about those five minutes, Board members.

After the final question period and closing remarks, there will be an opportunity for interested members of the public to provide brief comments for the record.

The Board will also entertain written comments on the investigation thereafter. If you wish to submit a written comment, you must do so no later than this Friday, July 21st. Again, submit your comments no later than Friday, July 21st.

Nothing in this investigation should be regarded as final or conclusive until the Board as a whole has had the opportunity to vote on the staff report some time in the next several weeks. If the report is approved, it will be published immediately and will be available by contacting the Board or visiting our Web site, which is www.chemsafety.gov.

Many of you here have some familiarity with the Morton accident. On the evening of April 8th, 1998, a violent explosion occurred at the Morton plant injuring nine workers and releasing chemicals into the surrounding community. The resulting fire took almost three hours to bring under control.

The explosion occurred in a 2,000 gallon reactor which experienced a runaway chemical reaction. We are all conscious of the tragic incident which occurred at Napp Technologies in Lodi, New Jersey, on April 21st, 1995. The Lodi accident claimed five lives and injured many more. This accident also involved a runaway chemical reaction. So it is entirely fitting that we meet here in New Jersey to hear the results of this investigation on the Morton accident.

Let me thank several organizations which have contributed to the Morton investigation. The Board has worked successfully with the Environmental Protection Agency, EPA; OSHA, the Occupational Safety and Health Administration; Morton Chemical; and PACE, the Paper Allied Industrial, Chemical, and Energy Workers International Union; and with local emergency response organizations.

We have also received contract support from the Department of Energy's Oak Ridge National Laboratory and from NASA.

I would also like to acknowledge the presence of staff representing the New Jersey congressional delegation. We thank them very much for their interest in the Board and in this accident investigation.

I believe several of you have brought statements from your members that you would like to read, and I will invite you to do so later this morning.

Finally, let me thank Mayor Barnes and the city administration of Paterson not least for making available their council chambers for this meeting.

With that, let me recognize Mayor Barnes, who is in our audience. Mayor Barnes.

MAYOR BARNES: Good morning, Board.

We wanted to come by this morning to welcome all of you to the City of Paterson. We have been able to look at some of the things that we've gotten so far, and we think this is going to be a very productive meeting.

So we're asking everyone to pay attention to see what's going on, and it's real important for all of us to understand.

But on behalf of all of the people of the City of Paterson, we want to thank you for your swift investigation and review and to keep us informed. So thank you very much.

DR. TAYLOR: Thank you, Mayor Barnes.

Thank you for those comments. Thank you for coming.

(Applause.)

DR. TAYLOR: With that, I'd like to recognize my fellow Board members for remarks that they may have.

Dr. Hill.

DR. HILL: Yes, thank you, Dr. Taylor. I will be very brief this morning.

I know it has been a long road to get to this point, and we've had our share of difficulties, but we're all here today to hear from the investigative team, and I'm just pleased that we have reached this very important milestone in this particular accident investigation such that something productive will come out of it hopefully, and we can provide recommendations to insure that this type of accident does not happen again.

I'm certainly anxious to hear from the team, as I'm sure people in the audience are. I welcome them, as well as others who may provide comments on this particular investigation as a result of Dave's presentation, and I look forward to hearing from the team.

Thank you.

DR. TAYLOR: Thank you.

Dr. Poje.

DR. POJE: If I could just echo those remarks, I'm very eager and happy to be here, thanks to the Mayor and the city for providing this wonderful space for us to do this presentation.

I think I would just like to say that the importance of the Morton incident is the lessons that we're going to learn from it. I'm eager to hear the presentation from our staff who have worked diligently to bring this product to the floor today.

But I also would like to reiterate what Andrea has said, which is that this is a pre-decisional meeting. It's a presentation to be educational for us, as well as for the audience, and the Board members will ultimately have to make decisions about this report.

Therefore, you should know that the Board members individually will make those decisions, and we welcome input from all of you or any of you on any matter or aspect of this investigation. During the break you can meet with us and feel free to get our cards. If you want to provide us with additional information, we'd welcome it, but clearly we share your enthusiasm about this becoming complete in a very short time framework. So we would like to work as expeditiously as possible.

Once again, thank you all for appearing here.

DR. TAYLOR: Thank you, Dr. Poje.

I will now turn this meeting over to our lead investigator, David Heller.

MR. HELLER: Thank you, Dr. Taylor and Dr. Poje, Dr. Hill.

On Wednesday, April 8th, 1998, at 8:18 p.m., an explosion and fire occurred during the production of automate Yellow 96 at the Morton International plant in Paterson,m new Jersey. The explosion and fire were the consequence of the runaway reaction of ortho-nitrochlorobenzene, or ONCB, with 2-ethylhexylamine, or 2-EHA.

Now, these are chemicals that have somewhat low reactivity by themselves, but in combination, we found that they were very reactive.

They over-pressured a 2,000 gallon kettle or reactor and released flammable material that ignited.

Because of the serious nature of the incident, including injuries to nine employees, the release of potentially hazardous materials into the community, and damage to the plant, the Chemical Safety and Hazard Investigation Board initiated an incident investigation.

Now, the purpose of the investigation was to identify the root causes of the incident and make recommendations to prevent similar incidents. This is a picture taken from the night of the incident. On the left is the building that experienced the fire. The fire fighters are just getting their attack going there.

This morning we'll be presenting to the Board a review of the incident, the key findings developed by the investigation, our determination of the root and contributing causes of the incident, and our preliminary recommendations to Morton, OSHA, EPA, and others to prevent a recurrence.

My name is David Heller. I'm an investigator with the Chemical Safety Board, and I come to the Board after 24 years in the private sector. My background is chemical engineering. I've been in the safety field for about the last 16 years.

Engineering experience included work as a production engineer, process engineer, technical manager, and in safety I've served as safety manager at multi-unit chemical plants and as manager of process safety and manager of loss prevention in the corporate safety offices of multinational chemical companies.

I'd like to introduce my fellow presenters. First, Mr. Richard Wedlich. Richard is the senior process safety specialist at Chilworth Technologies, Incorporated, and Mr. Wedlich will be presenting the results of work conducted by Chilworth to examine the thermal hazards of the Morton process.

Secondly, Mr. William Hoyle, who is the Chemical Safety Board's Director of Investigations and Safety Programs, and he'll be presenting the Chemical Safety Board's recommendations.

Let me say a few words about our investigation process. The Chemical Safety Board received and shared information with OSHA, EPA, and local emergency response organizations. We examined physical evidence from the incident. We conducted interviews with Morton personnel, and we reviewed relevant documents obtained from Morton.

We were assisted in our field work by contractors from the Department of Energy's Oak Ridge National Laboratory and the NASA, National Aeronautics and Space Administration, or NASA's White Sands test facility. The laboratory testing of the Yellow 96 process and processed materials was conducted for us by both the White Sands test facility and Chilworth Technology, Incorporated.

Also, at this point I'd like to acknowledge and thank the following organizations who assisted us or provided information during our work: EPA Region 2 and EPA's CEPO (phonetic) office; OSHA Region 2 and the OSHA Process Safety Services Group; Passaic County Department of Health; Paterson Fire and the Police Departments; the United Kingdom's Health and Safety Executive; the Center for Chemical Process Safety; PACE, the Paper Allied Industrial Chemical and Energy Workers International Union; and Morton International.

What I'd like to do now is summarize the root and contributing causes of the event to give you all a context as we present the details of the case.

First, neither the preliminary hazards assessment conducted by Morton and Paterson during the design phase in 1989, nor the formal PHA conducted in 1995 addressed the reactive hazards of the Yellow 96 process, and not addressing these hazards resulted in design, operational, and training deficiencies. The kettle did not have adequate cooling capacity to handle the exothermic synthesis reaction to make the Yellow 96, and an exothermic reaction or exotherm generates heat as a byproduct of the chemical reaction.

The kettle was not equipped with safety equipment such as a quench system or a reactor dump system to stop the process to avoid the runaway situation.

Rupture disks, and these are safety devices which are put on the kettle and are designed to open under high pressure to protect the equipment and personnel from a catastrophic failure of the vessel; well, the rupture disks on the vessel involved in the incident were too small to safely vent the kettle.

Operating procedures. The operators used to run the process did not cover the safety consequences of deviations from normal operating limits that could lead to a runaway reaction or the steps to be taken to avoid or recover from such deviations, and training did not address the possibility of a runaway reaction and how operators should respond.

The process safety information provided to the plant operations personnel and the team doing the formal PHA did not warn them of the potential for a dangerous runaway chemical reaction. Morton researchers had documented that the desired reaction to form Yellow 96 was exothermic, and that Yellow 96 would begin to decompose rapidly or run away at temperatures close to the upper operating limit -- operating temperature.

And the operators and supervisors were

unaware that a dangerous and undesired decomposition reaction was possible. Now, decomposition reaction occurs when a chemical breaks down into smaller molecules after being exposed to an elevated temperature, and liberation of large amounts of heat and the generation of high pressure may accompany decomposition reactions.

Third, process development did not address important aspects of the reactive hazards. Morton converted their process during the design phase from a staged addition or semi-batch process to a staged heating or batched process without adequately assessing the possible hazards of this change, and it likely would have been easier to control the heat outfit from the semi-batch process than the batch process.

Also, Morton did not investigate whether the kettle had sufficient heat removal or venting capability.

We also identified two contributing causes. Contributing cause number one, the hazards of operational deviations were not evaluated. Mansurin (phonetic) did not investigate evidence in numerous completed batched sheets and temperature charts of high temperature excursions beyond the normal operating range.

And Morton did not follow their management of change procedures to review changes made in the size of the kettle and the size of the batch. Morton changed the Yellow 96 processing equipment from 1,000 gallon kettles to 2,000 gallon kettles and increased the batch size by nine percent in 1996, and they did not use their existing management of change procedures and did not review the changes for possible consequences.

Now some background on the Morton facility and the Yellow 96 equipment in process. Morton International, Incorporated was a major salt producer and the maker of specialty chemicals for a variety of applications. Morton developed the automate Yellow 96 dye product in the 1980s, and combined with other dyes, automate Yellow 96 produces bright green shades of die, and they're used to tint fuels.

Morton does not make Yellow 96 at this time. However, the lessons learned from this investigation are certainly important for the chemical processing industry as a whole.

I should add at this point that the Chemical Safety Board is not presenting certain details of the Yellow 96 process or the process chemistry due to Morton's assertions of confidential business information.

And also, as Andrea mentioned, in February 1999, Morton became a wholly owned subsidiary of Rohm and Haas.

DR. TAYLOR: David.

MR. HELLER: yes.

DR. TAYLOR: I just wanted to ask: can everyone hear in the back? I see some straining. Can you pull it just a little bit up closer to your -- okay. There you go.

MR. HELLER: All right. We'll try that.

The Paterson facility is located in Passaic County. It's on a nine acre site surrounded by other industrial establishments and residential homes. From this aerial view, we can see the plant is bordered on the west by New Jersey Route 20. That's McLean Boulevard, and on the east by the Passaic River.

The accident occurred in Building 11, which is one of the three floor building on the east end of the site, and kettle seven was in this upper quadrant here. Again, this is the Passaic River right out here.

Industrial dye products that were manufactured in the plant are by batch processing, and mixing occurs in reaction vessels, again, called reactors or kettles. Various raw materials are mixed in the kettles, and heat is applied to drive the reaction process.

The resulting dyes are further processed after the reaction step to remove residual chemicals and waste products, and the final product is put into drums or transferred into storage tanks, and it's either shipped off site at this point or blended with other products to produce other colors.

Now, again, I noted that from 1990 to 1996 Morton produced the material in various 1,000 gallon kettles. In September 1996, they switched to 2,000 gallon kettles, and that was to minimize color contamination which you can get if you're making different chemicals in the same reactor.

Kettle number seven was the kettle that was involved in the incident, K-7, and that was one of the 2,000 gallon kettles.

This is a simplified flow sheet of the process with the reactor there in the center. The kettle K-7 was designed and manufactured in 1962. The interior of the kettle was glass lined to prevent corrosion of the carbon steel shell and heads. A heating and cooling jacket surrounded the outside of the kettle.

This is an annuler space, sort of like a thermos bottle. This surrounds the outside of the kettle, and steam or cooling water would go into this area so that it wouldn't contact the materials inside the batch to provide steam for heating or cooling water, obviously for cooling of the batch.

The kettle had a maximum allowable working pressure of 100 pounds per square inch, and the rupture disks, again, the safety devices on the kettle, were set for ten pounds per square inch.

And to give you an appreciation of the scale and the operator's movements as we get into the time line of the event, the diameter of the kettle with the jacket was about seven feet.

Nozzles were located on the jacket for the steam and the cooling connections and also on the top head of the kettle to provide piping connections. So on the top there was one single speed agitator that would have extended down. You can see still on the schematic the agitator extending down into the kettle, and also there was a man-way. This was a 14 by 18 inch man-way, and it was bolted on by four C type clamps.

Now, on the other nozzles on the top of the kettle, there was a thermocouple for measuring temperature. I'll talk about that more in a minute. This was a nozzle for the rupture disks to extend away from the kettle. D was a return from the overhead condenser. E is a raw material feed port. F was the two inch vent line, vent for the kettle. G was the line to the overhead condenser, and this was a glass line. You'll see a picture of that later on, and there's another raw material feed that you can't see that's hidden behind the agitator.

The kettle extended vertically from the second floor down to the ground level, and the operators would work from the second floor deck. You can see the dotted line is the second floor deck up here. So they had access to the tops, the top of the kettles, the man-way, and the instrumentation, and the valve handles from the cooling and the steam were pulled up through the deck so that the operators could have access to those valves even though the valves themselves were underneath this second deck which was a steel grating.

Okay. So the cooling water and the steam flow are controlled by manually operated valves, and the operators determine the degree to which these valves were opened based on their experience in running the process, and also the timing of switching from a heating to cooling and back was also based on the operator's experience.

Now, reactor instrumentation provided measurements of the reactor temperature, the reactor pressure, and the cooling water pressure. And temperature was measured by one thermocouple which was connected to two temperature readouts.

There was a circular chart in this box here, and that chart could record temperatures up to 150 degrees Centigrade, and then it was maxed out, and you couldn't see anything above that.

The operators also had a digital readout in this small, rectangular box that was also on that same box with the temperature chart.

Now, the kettle was not equipped with temperature or pressure alarms, and there were no automatic shutdown devices, and everything you hear in the presentation will be in degrees Centigrade or Celsius unless I specifically mentioned that it's Fahrenheit.

Let me break at this point before we get into the time line of the incident and see if there's any questions from the Board.

DR. TAYLOR: I have one. I wanted to ask about the temperature gauge. Where was it located exactly?

MR. HELLER: Right. That's on the wall.

So it was the kettle -- you have the kettle in front of the operators and then the temperature gauge was on the wall behind the kettle.

DR. TAYLOR: Behind the kettle. Okay.

And then the second question was regarding, again, how the cooling versus the heating of the --

MR. HELLER: Right. I'll explain that in quite a bit more detail as we get into time line and as the operators went through those various steps, and I have some schematics that show that a little clearer.

DR. TAYLOR: Okay. Other Board member questions?

DR. POJE: Yeah. Can you tell us what the assertion of confidential business information meant in terms of your ability to draw findings and recommendations?

MR. HELLER: It really didn't affect the results of the investigation. Our findings and conclusions really weren't critical to the findings and conclusions of the investigation. So it was not an issue for us to protect those claims.

DR. POJE: And one more thing. Did you notice anything unusual about the mechanical integrity of any of the equipment that would indicate a potential failure that was out of the norm?

MR. HELLER: No, there was nothing that we saw in our investigation or in the materials we obtained that indicated anything untoward on the equipment.

DR. TAYLOR: Other questions?

(No response.)

DR. TAYLOR: Okay.

MR. HELLER: I would like to now get into a description of the incident itself. On April 8th, the second work shift started at 4:00 p.m., and during this shift Yellow 96 was going to be prepared in kettle K-7.

Plant batches had been numbered sequentially from the beginning of production in 1996, and this was going to be Batch No. 32.

The operators used batch sheets for step-by-step guidance in performing the process. The batch sheets were written and approved by plant management and supervision and operations personnel. The Yellow 96 batch was about nine pages long and included processing steps following the reaction that are not germane to our discussion, and those were the clean-up and the final processing to get the product ready for sale.

The batch sheets also had abbreviated safety data sheets, and they listed the key health hazards and personal protective equipment for raw materials and the products, and on the batch sheets, the operators record the time when each step began and ended, the temperature of the kettle contents during that step, and their initials and also their comments, if they had any, on the batch at that point in time.

And the batch sheets for Batch 32 were not recovered after the incident.

Now, both operators involved in the incident had made Yellow 96 before. The lead operator had 31 years of plant experience, and the assistant operator had more than three years of plant experience.

Before beginning the batch, again, Batch 32, the kettle was inspected, and the operators did that by looking down through the man-way to insure that it was clean and empty, and they reported that it was, and the kettle at this point was at ambient temperature of the room.

Once they had done that inspection, the operators closed the man-way and clamped it, and again, we saw earlier the four C clamps that were used to bolt down the hatch.

And the first processing step after that was the addition of the ortho-nitrochlorobenzene, or ONCB, to the kettle.

Now, ONCB has a melting point of 32 degrees C., which is about 90 degrees Fahrenheit, and so it would have been a solid at room temperature. So in order to process it, the drums were placed in a hot box for several days to be melted before use, and the hot box was an enclosed room with a steam heater, and it was large enough to contain the drums.

The drums were taken out of the hot box then this afternoon, and they were brought up by fork lift to the building and by the building elevator up to the second floor, and only the Yellow 96 operators and their material handling helpers remained in the building during the addition of the ONCB, and they wore protective equipment.

Operators running the other processes in the building left the building to avoid exposure to ONCB vapors, which is toxic.

A vacuum was used to draw the ONCB from the supply drums into the kettle, and that was using a combination of piping and flexible hose. At this point the vessel agitator was started, and it remained on through the balance of the operation.

The transfer to the ONCB was normal. It took about 30 minutes, until 5:15 p.m., and once the transfer of the ONCB was completed, the temperature inside the kettle was reported by one operator to be, quote, 60-something degrees, almost 70, and by the second operator it was about, quote, 44 degrees.

And I'd like to note here that these sorts of discrepancies in times and temperatures reported by operators and supervisors and interviews, it's not unusual in this incident; it's not unusual in any incident, and given the stress of the situation as you'll see in a few minutes, it's completely acceptable.

And our time line here is really our best estimate of the times and temperatures of the event. Now, after the ONCB was added to the kettle, the Yellow 96 operators left the building, and the building was kept empty for about 30 minutes to air out the working areas, again, due to the toxicity of the ONCB.

At six o'clock, the operators returned to the building, and the next processing step was the addition of the 2-ethylhexylamine, or 2-EHA, and the operators opened the kettle vent to insure there was no build-up of pressure when the 2-EHA was added, and the operators left this vent open during the duration of the operation, allowing the process to be performed at atmospheric pressure.

And appropriate valves from the 2-EHA

underground storage tank were opened. Digital pump delivery meter was set, and the material was added, was pumped into the kettle, and that transfer took about 25 minutes.

And after adding the 2-EHA, the operators left the building for dinner, returned about 7:35.

Now, following the addition of the 2-EHA, which was at ambient temperature, the operators stated that the mixture in the kettle was now about 44 to 48 degrees Centigrade.

Now, as we'll see, the onset temperature for this desired synthesis reaction is 38 degrees Centigrade, and so it was likely that the reaction to produce Yellow 96 was already occurring, albeit at a very low rate at this point in time.

Now, the onset temperature of a reaction is the temperature at which a reaction becomes capable of sustaining itself with no input of external heating.

Also, you should note that the 2-EHA is a combustible material and has a flash point of 52 degrees C., and ONCB has a flash point of 127. So both substances were above their flash points during a portion of the normal process and during the runaway event, and flash point is the temperature at which a substance generates sufficient vapors to ignite given the presence of an ignition source and air.

The staged heating procedure used by Morton to produce Yellow 96 started with an initial heat-up of the reaction mixture to 90 degrees C., with gradual increases thereafter to 100 to 150 degrees C. This processing step was designed to raise the temperature slowly, and the expected reaction time for a batch was six to eight hours.

So at approximately 7:40 p.m., the lead operator began to raise the temperature of the mixture by introducing steam into the kettle's jacket, and you can see that in the red here.

And, again, the steam and the cooling water valves were grouped on opposite sides of the kettle operated by hand wheels which extended through the operating deck down to the valves below.

The lead operator applied steam to the kettle for about ten minutes, stopping when the kettle's jacket pressure read five to ten pounds per square inch, and he repeated this step two more times, watching the digital temperature readout.

And as the temperature rose, he noticed that unlike most batches, the rate of the kettle's temperature increase was unusually fast.

The lead operator recalled that the

temperature of the batch rose quickly from 70 to 80 degrees C., and that the tenths decimal reading of the digital temperature indicator, again, the small rectangular indicator, was moving very fast.

This rapid temperature rise began within the first 15 minutes after the start of heating, and the typical heat up rate during this phase of the process would have been only one to two degrees per minute.

At approximately 8:05 now with the temperature at about 100 degrees C. and rising rapidly, the operator switched from heating the reactor to cooling by closing the jacket steam valves and opening the water valves.

Let's see. If we switch to the cooling mode, where steam came in the top and the steam that condensed as the heat went into the reactor and left as liquid went out the bottom, cooling water would go in the bottom of the reactor and come out the top, and that's pretty much a typical operation.

So they switched over to the cooling water. Three other operators, experienced operators, became aware that there was a problem, and they came over to assist. They asked if the cooling water was on, and at least one of them verified that, yes, the cooling water valve positions were correct.

The lead operator reverified the valve positioning, and the operators stated in interviews that they heard the sound of the cooling water in the piping, and I think that's a common measurement or indicator that operators use to know that there is water flowing.

About two minutes passed, and the supervisors called the supervisor over to assist, and he again verified that, yes, the valves were all configured properly.

Now, at this point the temperature had reached 150 degrees, and the circular recording chart only went up to 150. So that pegged out or maxed out, as we say and could no longer provide any indication to the operator of the temperature, and they were working off of this small digital readout, which was above it.

DR. TAYLOR: How did you get that?

MR. HELLER: Yeah. Now, at this point the kettle starts to shake and rumble. The batch temperature again continues to increase, and it passes the onset of the decomposition reaction, which is 175 to, as we'll see, 195 degrees.

The decomposition reaction, again, as I mentioned earlier, is the breakup of a molecule, in this case the Yellow 96, into smaller molecules with the generation of high temperatures and pressures, and again, the kettle was rumbling and shaking more violently.

And the operators at this point observed vapors and liquid in the glass piping section that connected the reactor to the overhead condenser on the third floor. So this would have been the reactor down here, and the condenser was up above, and this was a glass section. So the operators could see the liquid, the vapor coming up and the liquid coming down, and all really just very agitated action inside there.

And this vapor was composed of residual 2-ethylhexylamine and gases that were being generated by the reactions, by the decomposition reactions.

Now, next, at this point the kettle's high pressure relief system, the rupture disks, the emergency protection, they activated, and they were set at ten psi. There was two six inch rupture disks that were set in series. You can see them here, and again, this was after the kettle was disassembled, but the bottom would have been on the nozzle at the kettle, the first rupture disk, and the second rupture disk, and this went off to a catch tank, which was designed to vent the kettle and contained the release from the kettle.

And now we're at 180 to 190 degrees Centigrade. At the point of disk failure now, one operator who had been standing near the kettle reported that he saw the digital temperature reading increase from 190 to 265 degrees C. in less than 30 seconds.

He shouted to several other operators and started to run towards an exit, and as he reached the top of the stairs, he heard additional sounds, including a gush of air which he associated with the failure of the glass piping section we saw in the previous slide.

And at ground level he shouted a warning to three more workers who were at that point unaware of the danger, and they all ran towards an exit.

At about almost the same time now, the one operator and the supervisor still at the kettle reported in interviews that they observed the temperature on the digital readout to be about 200 degrees Centigrade, and at this point, the operator and the supervisor ran toward the second floor northeast exit.

Again, the kettle was vibrating the second floor steel decking, and there was a very loud rumbling. Other workers on the site though that it was the sound of a train passing by the plant.

And the operators came out that upper door to get out of the building.

At 8:18, the pressure in the kettle blew the inspection man-way off, and the man-way was found about 15 feet from the kettle. In this picture, you can see the scars where the man-way pulled away from the four clamps that were holding it on.

And from the open vessel man-way now, a jet of hot reactants erupted that essentially emptied the vessel, and the reactants penetrated the third floor and the roof, and this aerosol mixture of gas and liquid shot above the roof and spattered the adjacent community with a yellow-brown mixture of compounds which included the yellow dye 96 and the ortho-nitrochlorobenzene.

The aerosol plume ignited and formed a large fire ball above the roof, and the recoil from the force of the material coming out of the kettle twisted the kettle off of its mounts, and you'll see here as soon as my slow computer catches up.

The kettle fell about four feet from where it was up on the second level. This was the second level decking that the operators had been working off of. The kettle would have been at this height, and it got twisted off and fell down to the first floor below. You see the open man-way here.

Now, as the operator and the supervisor reached the second floor exit landing, the explosion blew then to the mid-level landing and flash fires spread in the building in the kettle area. The lead operator and the supervisor were further blown from the mid-level landing down to the ground, and they suffered second and third degree burns, and they were hospitalized and in intensive care for five days.

Injuries to the other workers included first, second, and third degree burns, contusions, abrasions, lacerations, and muscle strains. All of Morton's employees were able to escape from the building before the arrival of the emergency responders.

The blast blew out the windows, doors and blow-out walls of the building, and that absorbed much of the energy of the explosion and prevented greater damage to the building.

There was some blast damage in the immediate vicinity of the reactor, but most of the damage was caused by the ensuing fire, and the second blast, as we noted, was above the roof outside, which again was away from the operators.

The Paterson Fire Department arrived quickly. They were there at about 8:24. The fire chief assumed command of the fire fighting effort, and he called for the sheriff's HAZMAT team, hazardous materials team.

Fire at this point, as we saw in that early slide, was visible burning through the roof of the building, and at this point there was about a 30 minute delay before the fire fighters could begin their attack in order for them to determine and get information from the plant to determine what chemicals were involved and to insure that the chemicals weren't water reactive and that water was the proper medium for fighting the fire, and it was. It turned out to be it was. So they were able to start on the attack with water.

Flames were suppressed in about an hour, but the fire department continued their water deluge to facilitate the HAZMAT team's entry for an initial surge at about 9:44 p.m.

The HAZMAT team conducted a primary and secondary search of the building. Again, all of the workers had fortunately escaped. The fire department then entered the building on the second floor, and they used a portable dry chem. extinguisher to extinguish the remaining fires.

At 11:37 the fire was reported under control, and the fire water was stopped as soon as possible to prevent washing contaminants over into the Passaic River.

Morton collected about 300,000 gallons of contaminated water from the fire fighting operations and from rain the next day, which they disposed of, and they estimated that less than 10,000 gallons of contaminated water, fire water and storm water, eventually reached the Passaic River.

Now, during the fire, the ambient temperature was about 40 degrees. It was a clear night with light winds mostly from the northeast switching to the southeast. These winds blew the plumes of the reactants' products and the smoke off the plant site, and the fallout was mainly to the west of the plant.

This picture is taken from the plant site, but it gives you an idea of the type of spatter from the dye as it came out of the kettle.

Now, spots were reported on cars in the neighborhood at an adjacent candy factory and at a car dealership about one-half mile away. White samples of the material deposited on automobiles and buildings near the Morton facility were taken, and these samples contained measurable -- I noted measurable quantities of these yellow dye 96 and the ONCB.

Nearby residents were order to shelter in place in their homes during and immediately following the fire fighting attack. The shelter in place was conducted by the Paterson Police Department and encompassed about a ten block by ten block area around the plant, and the shelter in place lasted for about two to three hours.

During and following the incident air monitoring was performed by various organizations. The testing conducted by the Passaic County Department of Health was negative for benzene and halogenated hydrocarbons and nitrous compounds.

Now, workers at two neighboring businesses and some fire fighters reported throat irritation and a slight burning in their eyes and on their skin, and several odor complaints were also received from neighbors.

A health warning statement was prepared by the Passaic County Department of Health and issued jointly with the Paterson Mayor's office, and it was distributed to the local community. It advised residents to avoid contact with the deposited material. It listed steps to be taken in case of health effects, and instructed the residents on how to handle contaminated items.

However, the warning wasn't issued until about five o'clock the following day or about 20 hours after the incident.

At this point, again, I'll stop for your questions.

DR. TAYLOR: Okay. Are there questions?

DR. HILL: Yes, Dave. This relates back to the question that Dr. Poje asked earlier about mechanical integrity. Did you use -- did you look at other things? We saw on some of the drawings there the glass lining, the impeller. Did you look at those things to eliminate them as a potential cause of this accident, including also the potential for contamination, if there were cracks in that material --

MR. HELLER: Right.

DR. HILL: -- that could have potentially catalyzed the situation and caused it to occur?

MR. HELLER: We looked at quite a number of alternate scenarios ourselves and with the contractors. The agitation, it was determined, had been on the entire time. The glass lining of the kettle was in pretty good shape. There didn't seem to be any faults there.

The cooling water system was checked out and had been operating as it was supposed to. We'll talk later about the raw materials. There was no contamination of the raw materials and testing that OSHA and EPA did after the incident.

And, again, these all maybe pointed to the direct cause of the incident, but as we'll see, they really don't reflect on the root causes of the incident and really any of these alternate scenarios.

DR. HILL: Did you also look at -- you mentioned that the operators indicated that, for instance, the water valves or the steam valves were in a certain position, but I understand those were on a stem all the way through the floor down to another level.

MR. HELLER: Right.

DR. HILL: During the physical examination was it determined that those valves were, indeed, in those places?

MR. HELLER: Yeah, the valves were in the proper position, and for the cooling water, it was pretty much all the way open or all the way closed, and I guarantee you these guys made sure those valves were wide open.

DR. HILL: Okay.

MR. HELLER: The steam, there was some

variation, but critical by the end was the cooling water, and they were determined to be wide open.

DR. HILL: You said you used a systematic process. Was this something like CCPS uses as a fault tree analysis to eliminate these other potentials?

MR. HELLER: We used a number of formal analytical tools. We used our contractors and also CSB did a barrier analysis, look at barriers, physical barriers, administrative barriers, engineering barriers between the hazards and protecting the people, and we did a change analysis which looks at what was different this time versus the other 31 times or versus this process versus other processes.

And we also did a fault tree, which is a formal root cause analysis tool.

DR. HILL: Okay. Thank you. That's all of the questions.

DR. TAYLOR: Gerry.

DR. POJE: Dave, you mentioned earlier that there were discrepancies, which is not unusual in such an emergency and stressful situation, in the witnesses' recall of temperature. How do you ascertain the significance of this in terms of your findings or in the recommendations? Did it have any influence, the range that people were talking about?

MR. HELLER: Again, these were really just the symptoms of this one batch, and as you'll see in a few minutes, they really had little impact on the root causes, the systematic causes -- systemic causes of this event.

DR. POJE: Okay. One other issue was raised in the time line about the fire fighters. Fire fighters arrived on the scene. How did they understand the hazards to begin their emergency response efforts?

MR. HELLER: All right. Typically what the fire fighters would do and what these guys did was get the information from the folks at the plant. I think they were set up near the front gate, and that's where they had to wait until that information could be gathered to make sure they knew what they were doing.

DR. POJE: And there was what, a 30 minute delay period, something that is unusual or normal in such situations? It seems like a long time to me.

MR. HELLER: It could have been a long time if there were people inside, and I think if there had been a situation where they knew people were missing, that there wouldn't have been a 30 minute delay, but with the people all accounted for, maybe they were able to back off rather than endangering anybody further to make sure they had all of the right information before proceeding.

DR. POJE: And then if we can just clarify, because I know we'll get into this section as well. My understanding with what you presented is that there are a number of important chemicals used in this process, ortho-nitrochlorobenzene, 2-ethylhexylamine. Individually and by themselves, they are not clarified or characterized as a high hazard or highly reactive materials on their own. Put them together and you have a desired reaction that you want to do to produce automate Yellow 96.

But then in addition to that, there's also an undesired reaction that if temperature goes high enough, the automate Yellow 96 starts to break down.

MR. HELLER: Right. The desired reaction is the ONCB and the 2-EHA, and the undesired was the breakdown of the final product.

DR. TAYLOR: I'm interested in the environmental impact. You mentioned that there were two workers, I believe --

MR. HELLER: No, no.

DR. TAYLOR: -- or three who -- outside of the plant who had complained --

MR. HELLER: From neighboring businesses, yeah.

DR. TAYLOR: -- of symptoms.

MR. HELLER: And some of the fire fighters.

DR. TAYLOR: Do you know if there was any follow-up of whether those individuals went to the hospital or to a physician or --

MR. HELLER: I really don't recall what they did. I know the fire fighter cases were reported through the department procedures for that. Now, we did not do any looking after the incident at any potential chronic effects of the exposure to the chemicals, and that's something that we're going to be trying to do a better job of in future investigations.

And to that end, we've started contacts with the ATSDR. That's the Agency for Toxic Substance and Disease Registry, and hopefully they'll be able to give us some assistance in that area as we hit new incidents in the future.

DR. TAYLOR: Okay, and the other question, you also mentioned that there was air monitoring conducted of the environment. Do you know how soon after the incident that was done?

MR. HELLER: The Passaic County Department of Health was monitoring during the incident. Morton contracted from independent testing that was done after the incident. EPA also -- I think it was the region --

did some testing after the incident. And there was, again, a lot of samples taken of the spatter in the neighborhood.

DR. TAYLOR: Okay. Thank you.

Questions? Okay.

MR. HELLER: Your questions on the chemistry are right on because what we're going to do now is get a little bit into the process chemistry of the event.

And, again, we said there were two reactions, the desired product forming or synthesis reaction and the decomposition reaction, and the exothermic heat of the reaction that formed the product accelerated faster than the heat removal capacity of the kettle and raised the temperature of the batch, and the heat generation caused the vapor pressure of 2-EHA to rise until it boiled.

The reaction generated additional gases which pressurized the kettle, and the heat release continued to raise the batch until the batch was above the decomposition temperature of the Yellow 96, and that decomposition reaction, in turn, released more gases, decomposition products, contributed even greater pressure, resulting in the final release of material from the kettle.

Now, Chilworth Technology, Incorporated, of Monmouth Junction, New Jersey, was hired by the Chemical Safety Board, and they conducted a battery of thermal hazards tests to analyze the Yellow 96 synthesis and decomposition.

So at this point, I'd like to ask Mr. Richard Wedlich of Chilworth to come over here and take over the computer and give us an overview of the thermal hazards work.

MR. WEDLICH: Please permit me to introduce my qualifications a little bit. I've been involved in the thermal hazards evaluation area for about 15 years now. I received a Master's degree at Marquette University in physical chemistry and started in the thermal hazards area at NASA White Sands test facility where I worked for about four years on NASA space shuttle and space station type projects.

From there I went to Olin Chemicals Research, which is the support center for a large chemical company. I worked there for about ten years in charge of the thermal analysis area.

After leaving Olin, I came to Chilworth Technology, where I've been employed for over two years as a senior process safety specialist.

Chilworth Technology is a professional

safety firm which provides consulting and testing services on a contractual basis.

In January of this year, Chilworth was contracted by the United States Chemical Safety and Hazard Investigation Board to implement an experimental study into the thermal hazards associated with the Morton process to prepare Yellow 96, and today I'm going to summarize the results of that study.

It's coming along.

I begin with a definition of the thermal runaway -- how do I get back? We can do the kinetic experiments. We just can't handle the laptop.

A thermal runaway is the progressive production of heat from a chemical process and occurs when the rate of heat production exceeds the rate of heat removal.

There are two competing factors which determine the thermal runaway condition. One is the rate of heat generation, and one is the rate of cooling. What you're seeing here plotted on the Y axis is energy per unit time. So that's the rate of energy either coming out of the exothermic reaction or in the way of a heat generation rate or the rate of cooling.

The curve which is exponential is the rate of self-heating, and the linear curve is the rate of cooling. There are two points on the curve where the rates are equal. Above the upper point cooling is insufficient. The reaction will undergo a thermal runaway that could result in a thermal explosion.

The events that lead up to a thermal explosion are predictable, and they tend to follow this profile. In the present case we're dealing with a batch reaction. So the accumulation of reactants starts out being 100 percent. In the case of insufficient heat dissipation, we can get into a runaway of the desired synthesis reaction. The reaction is not being controlled. The temperature is increasing. As the temperature increases, one can reach a point where the undesired decomposition reaction takes place.

We still have insufficient cooling, and the combination of these two things can lead to the thermal explosion.

The safety data required is illustrated here in terms of the event profile. What's being plotted on the Y axis is temperature versus time. At some critical point, TX, cooling is lost where cooling becomes insufficient, and the desired synthesis reaction gets out of control and there's an adiabatic temperature rise. Basically the system goes fairly adiabatic. Large reactors tend to be fairly adiabatic. There's very little heat loss.

Depending upon the amount of energy stored in the reactor, the maximum temperature of the synthetic reaction will be reached. In this case I've drawn it so that that temperature is high enough to trigger a decomposition reaction. The decomposition reaction then takes place rapidly. They tend to have large adiabatic temperature rises. Decomposition reactions tend to generate rates of pressure that are quite large.

It is possible to define cases now based upon the desired synthesis reaction and the undesired decomposition reaction that are harmless, that are feasible, that are dangerous. What I'm showing you here on the Y axis is temperature. P stands for the desired reaction, the synthesis reaction, and S stands for the undesired decomposition reaction.

In the first case, I'll take as an example the safe case. We've got the synthesis reaction going out of control, and they're going on a thermal runaway and reaching a maximum temperature, Tmax, which is less than the onset temperature, TS of the undesired decomposition reaction. this is generally safe.

It's made safer by the fact that the

adiabatic temperature rise on the decomposition reaction is not very large. So the highest temperature reached will not be very high. So the highest rate reached will not be very high. The maximum pressure reached will not be very high.

In this case here, we've got a dangerous case where a synthesis reaction can take us to a temperature where the decomposition can occur and the adiabatic temperature rise on the decomposition reaction is quite large.

For the purpose of studying the thermal hazards, we tend to break the problem up into studying the decomposition and separate from studying the desired synthesis reaction. There are a host of routine tests that can be done. These range from screening tests that can be done very quickly in a matter of a couple of afternoons by qualified people for a very minimal cost. Maybe 1,000 or a couple of $1,000 can get you through a screening.

Then there's a more dynamic test which I've shown here, which is what Chilworth Technology uses to study the desired reaction.

This is the heat flow calorimeter, the metlerized (phonetic) C-1 heat flow calorimeter. This is a two liter glass reactor that we have, which is a jacketed reactor that allows us to circulate cooling or heating oil through the jacket, and what we did was we ran the process, the Yellow 96 process, in a semi-batch fashion where we actually dosed the one component, the amine, into the nitrochlorobenzene, and we did this in small stages, and we measured the heat output at each stage.

This allows us to calculate the heat of reaction, and this device also allows us to measure the heat capacity. Having those two values, we could calculate the highest temperature that could be reached by the synthetic reaction if cooling was lost. I called that the MTSR previously.

For studying the decomposition reaction on a fairly large scale, we use what's known as the adiabatic pressure Dewar calorimeter. This is the vessel. It's a one liter thermos bottle. It's very insulated. This one is made out of stainless steel, will hold fairly large pressures.

The batch was charged to this reactor. The reactor was placed inside an adiabatic shield oven, and the batch was raised to 90 degrees very quickly, relatively quickly, and then allowed to do its thing while we're monitoring the time, temperature, and pressure data.

Because this reaction, because this scale of experiment can be quite dangerous, quite large pressures can be generated; the entire calorimeter has to be placed inside a vented blast room. This would be a room capable of containing the fragments from an explosion and also for properly ventilating the material out of the way of the laboratory personnel.

Now, I'm going to talk fairly slowly through this slide, which sort of summarizes our results. The X axis doesn't mean anything in this case, but the Y axis is in units of temperature.

First, let me just remind you of what kinds of tests were being done. I did not mention the Carius tube test. It's a test where the materials are being added to a glass tube. The glass tube is instrumented with a pressure transducer and a thermocouple. The tube is then ramped up in temperature, and we're looking for evidence of exothermic activity.

I did mention the Dewar or the adiabatic pressure Dewar.

The DSC, this is an inexpensive, fast screening test, differential scanning calorimetry, very similar to the Carius tube test. The batch is charged to a small stainless steel reactor and heated up, and again, we're looking for evidence of an exothermic reaction.

The RC-1 is the heat flow calorimetry experiment that I described for studying the desired synthesis, and the boiling point on this material, this is the boiling point of Yellow 96. This was determined at reduced pressure, and then we used a common technique to extrapolate the data to the atmospheric boiling point.

Let me show you how you would read this. For example, this bar here, this represents the reaction to exotherm. Starting at 40 degrees Celsius, there's enough heat that can be generated by this process to take us up to 213 degrees Celsius based upon the experimental heat capacity and experimental heat of reaction if there were no cooling.

In the Carius tube test, we found evidence of exothermic activity as soon as 38 degrees Celsius. This is just beyond the melting point of the ortho-nitrochlorobenzene. So the synthesis reaction starts generating heat that can be detected by our instrument as low as 38 degrees Celsius.

As the synthesis reaction is allowed to go out of control, you easily get to the 90 degree mark. You can see that. When the batch is added to the adiabatic Dewar at 90 degrees, by the time the batch reaches 90 degrees, it's already running out of control. The thermal runaway reaction is very rapid and takes us up to a temperature above our experimental detection limit of 300 degrees Celsius. So we can only go up to 300, and this one went up to 300 basically and then some.

Also, I point out here that -- well, let me say this: that as the synthesis reaction then occurs and runs out of control, it triggers the decomposition reaction, and that allows us to get up to even higher temperatures, and we pass through a regime starting at about 172 where one of the components, the amine, can undergo a decomposition as evidenced from our DSC results.

We also note that by the time we reached 195 degrees Celsius, our Carius tube test has shown that the crude product begins decomposing, and by the time we reach 201 degrees Celsius there's, in addition to the large vapor pressure, there's also permanent gas being generated.

So that's a summary of Chilworth's experimental findings. That just shows you the temperature regimes and how one can go from one temperature to the next by these different thermal chemical mechanisms.

This is the actual data from our Dewar test. This is the adiabatic test where the batch is charged all at once to the Dewar, and in this case we are heating the sample rapidly, fairly rapidly, over a period of about an hour to 90 degrees Celsius. By the time we reach 90 degrees Celsius, the external heating from our calorimeter was turned off, and all remaining heat was being generated by the reaction, and you can see the very rapid rate of temperature rise and also the very rapid rate of pressure rise, and the rate was very rapid, and in fact, reached the bursting pressure of the vessel and did, in fact, cause the vessel to rupture.

That's my presentation.

DR. TAYLOR: Thank you.

I'd like one question just to clarify to make sure that I understand. What you're saying, with this reaction at 38 degrees Centigrade with the combination of the two chemicals, without adding heat, the steam or cooling, that temperature without adding the heat, in particular, the temperature will rise gradually to create decomposition? At some point it could do that?

MR. WEDLICH: Yes.

DR. TAYLOR: How long would it take

normally in that case? What would be the time?

MR. WEDLICH: I'm afraid I don't have that information with me. That's part of our report to you.

DR. TAYLOR: Okay.

MR. WEDLICH: The times involved.

DR. TAYLOR: Okay.

MR. WEDLICH: In fact, that is important information, but I don't have it off the top of my head. I apologize.

DR. TAYLOR: Okay.

MR. WEDLICH: You can see though from this plot, that there is a very short period of time once the batch reaches 90 degrees. I don't have the time off the top of my head from 38 degrees. It could be quite long, but from 90 degrees, you can see that there's really just, well, here is 90 degrees. There's a matter of less than an hour, clearly less than an hour before we reach the maximum rate.

DR. TAYLOR: For the maximum rate, and that's without any additional steam.

MR. WEDLICH: Yes, and notice that as you get closer, notice that as you get closer, you know, to -- as you creep up to, say, 100 degrees or 120 degrees, the time to maximum rate, the time that is to get to the largest rate reached, it's very, very short.

DR. TAYLOR: Very short.

MR. WEDLICH: Okay. The nature of this phenomenon is that it can spend some long times at the slow rates, but once it gets up to the higher temperatures, it will go very, very quickly.

DR. TAYLOR: Okay. Thank you.

Other questions?

DR. HILL: Mr. Wedlich, I'm certainly impressed with your credentials and your experience in this area, and clearly having your working contributing to the CSB's investigation is very important.

This is an area that it seems that we need to rely on your experience. So I'd like to put it in a little bit simpler terms. Clearly these materials when you put them together, they create heat. Now, they give off heat. If that's manageable, it can be controlled, if it is managed properly, I should say.

I have one question. You presented hazard cases there earlier, and they ranged from safety to harmless, all the way up to dangerous in a particular slide that you showed. How would you characterize your view of this particular material in this case relative to those hazard cases you presented?

MR. WEDLICH: Yes. I would call this dangerous.

DR. HILL: It was standard?

MR. WEDLICH: No, I'd call this dangerous.

DR. HILL: Dangerous. Okay.

MR. WEDLICH: Yes.

DR. HILL: Thank you very much.

DR. POJE: And if I can just get you to clarify once again, the tests that you're doing or have done on behalf of our analysis of this reaction are tests that are not so unique to your facility that they can't --

MR. WEDLICH: No, no.

DR. POJE: -- be duplicated elsewhere, and that they are possible for other facilities to use in ascertaining their own reactive chemicals.

MR. WEDLICH: Yes, that's absolutely correct. Most of the major pharmaceutical and chemical companies do have the in-house capabilities for generating the majority of this data.

DR. POJE: Thank you.

DR. TAYLOR: And what was the approximate cost of conducting such a test again?

MR. WEDLICH: The screening test that would indicate exothermic activity and the potential for gas generation, if you were to go through Chilworth Technology, which I hope you would do that, you can get approximately $2,000, but the entire program is probably closer to under $10,000 for the large scale testing and whatnot. Still you could come in for well under $10,000.

DR. TAYLOR: I was not trying to make this an add-on, but okay. Thank you.

MR. HELLER: Thanks, Richard.

Let me now discuss just one or two aspects of the chemistry relating to the process. The operating procedures for Yellow 96 state that the operator should heat the reaction mixture to 90 degrees C. to initiate the reaction. However, the operators' experience in making Yellow 96 was that following those procedures resulted in an exothermic reaction rate that was difficult to control.

And the operators, they thought that the reaction between the 2-EHA and ONCB started -- well, they thought it started as early as 75 degrees C. So most of the operators turned the steam heating off when the reaction temperature reached approximately 70 to 80.

And we confirmed the operators' observations and obviously saw, in fact, Chilworth's testing determined that the onset temperature for the synthesis reaction was as low as 38 degrees C. So, therefore, the reaction would proceed slowly, even at temperatures lower than thought by the operators.

Now, NASA's White Sands test facility and also Chilworth conducted differential thermal analysis testing for us on the two raw materials, on the ONCB and the 2-EHA, and no exothermic reactions or pressure spikes were detected in those individual reactants until their temperatures were well above the Yellow 96 process operating temperatures.

And after the incident, OSHA and EPA analyzed the unused raw materials and determined that those reactants were within the expected quality range.

Again, as far as alternative scenarios, there's one way to determine that there was no contamination at least from the raw materials in the process.

Now we're going to move away to discuss how Morton developed the Yellow 96 process. Yellow 96 went through several research phases at different branches of Morton. The company began its research with small scale reactions in 1986 at research facilities in the United Kingdom. Larger batches were produced there in 1987 and 1988, and the Morton researchers observed exothermic activity in these tests.

In 1987, Morton contracted with Brunell

University in the United Kingdom to perform differential scanning calorimetry testing of the reaction, and this is, as Richard will attest, this is one of the typical first pass screening tools that companies use to assess exothermic activity in new products.

And in these tests, the researchers found, quote, "The material was found to decompose with considerable generation of heat at above 220 degrees C."

And because of that, Morton developed a semi-batch or a staged addition process to control the exothermic reaction, and what the research would do is they'd put their 2-EHA and their test vessel, and they'd add the ONCB in the four equal portions. So you have the 2-EHA, and then they'd put in a quarter --it goes back to about a quarter of the ONCB, heat it up, let the temperature go up, and then they'd catch you with the cooling water. It would come back down, and then they'd put in the next portion of the ONCB and two more times in order not to have it all reacting all at one time. That was the process that was used in the United Kingdom.

Now, the researchers in the United Kingdom wrote a review memo of the process in 1989 in which they made a number of recommendations regarding the control and safety of Yellow 96. That memo was faxed to the Paterson plant in April of 1989.

The researchers recommended, among other things, controlled cooling water addition directly into the reactor, and that would have been an emergency method to stop the runaway reaction.

And this process review memo also included the recommendation that accelerating rate calorimetry testing be done. This is another step maybe beyond that first screening phase they did. It would have given them some more precise information, and the researchers wrote, and I'm quoting again -- the accelerating rate calorimetry testing would allow them to determine "the rate of reaction under the worst reaction conditions, the rate of decomposition of the finished product, and pressurized data which could be used to size emergency venting equipment," end quote.

Now, Morton did not perform these additional tests, and it did not install the recommended safety equipment.

In late 1989, Morton transferred its research effort on Yellow 96 from the United Kingdom to the United States, and at this point in time, Morton revised the process from the semi-batch process that the researchers use to a full batch process, and this was to minimize the exposure of the employees to the ONCB.

So, again, the semi-batch process was to put the 2-EHA in the vessel, add the ONCB and four portions. After each portion the temperature goes up. You put the cooling water on and pull the temperature back down after it reacts away.

They switched that to a batch process where you put all of the ONCB in the reactor. Then you put all of the 2-EHA in the reactor and heat the entire mixture up to 90 degrees C. to kick off the reaction, and then gradually take that heat up to 150 degrees C.

Now, Morton did not take into account that switching from their initial semi-batch process to the revised batch process, resulting in a more hazardous condition.

And the Center for Chemical Process Safety as a book out called Inherently Safer Chemical Processes, and in that book they note, "Semi-batch or gradual addition batch processes," and that was Morton's initial process, "limit the supply of one or more reactants and increase safety when compared to batch processes in which all of the reactants are included in the initial batch charge," and that was

Morton's production process.

For an exothermic reaction, the total energy reaction available in the reactor at any time is minimized, again, minimized in the semi-batch process.

Now, the United Kingdom's Health and Safety Executive, which is their government equivalent to OSHA and EPA, they have a recent publication out when they write about semi-batch processes. Again, quoting, semi-batch processes "reduce the quantity of reactant present and controlling the addition step may stop the reaction in the event of a hazard arising."

So at the start of the reaction of the batch process with the reactant concentrations at their maximums, the influence of temperature on the reaction rate was greatest, and there was the most danger of exceeding the heat removal capacity of the kettles.

Morton also produced six trial or pilot scale batches, and these are in sizes of from 80 to 425 gallons, and again versus the 1,000 and 2,000 gallons we saw in the Paterson facility, and these were done at a pilot facility in Illinois.

In these batches, Morton was able to control the exothermic reaction within the operating limits.

Now, to bring the reaction now from the

pilot scale to Paterson, the Paterson staff used a pre-manufacturing process review checklist as a guide, and this was in 1990. The Yellow 96 checklist required an information package, and that was received from the pilot plant, and that included batch sheets from the pilot plant, material safety data sheets, and memos and notes relating to the process, and some of these memos noted the presence of the exothermic reaction.

Now, Morton did not conduct an initial hazards assessment when they brought the process to production scale in 1990. The hazards assessment and the process hazards analysis techniques were in use throughout the chemical industries at this time. They've been gathered and published by the Center for Chemical Process Safety in 1989, and again, that was three years before OSHA promulgated the process safety management rule.

And the Center for Chemical Process Safety is an industry driven professional organization, and it's affiliated with the American Institute of Chemical Engineers.

The observations by Morton's researchers of the several laboratory and pilot scale batches performed in the United States were the determining factor in Paterson's analysis of the safety of the process. However, empirical ability to control the process in the laboratory and the pilot plant should be augmented by additional key engineering work. To design a safe reactor process, certain basic information is required.

Now, Morton did not conduct the additional calorimetric testing as recommended by the United Kingdom researchers or when the process was changed from the staged addition process to the staged heating process, from the semi-batch to the batch, and this information would have characterized the reaction, the runaway reactions, and provided data for the determination of the cooling capacity and the vent sizing of the reactor.

Morton did not calculate a heat and mass balance around the kettle in the reaction to determine if there was sufficient heat removal capacity in the reactor cooling water system to handle foreseeable events and to determine the influence of reactor vessel size in this function.

One could have done that and determined whether the reactors in Building 11 were acceptable for producing Yellow 96 or not.

And Morton did not determine the worst case venting scenarios and sized the reactor's safety devices accordingly. The pressure relief devices on the Paterson reactors were sized for the scenario of an external fire boiling xylene in the kettle, and that's a much smaller venting requirement than the runaway exotherm case.

And Morton did not do the calculations to determine if the relief devices could safely vent the pressure generated by the runaway, and they did not check to see if the reaction vessels were maybe strong enough to safely contain the maximum expected pressure.

And a break at this point on the development.

DR. TAYLOR: Questions, Board members?

DR. HILL: Dave, just a rather simple question. What you've just told us is that there was a lot of information available on the background chemistry of this particular reaction, but there was first a failure that somehow that information did not get transferred to the U.S. when production began here. Any understanding as to why that didn't occur?

MR. HELLER: I really couldn't pin that down, and most of the people that had been involved at that time in 1990 were no longer available.

DR. HILL: They've since moved on?

MR. HELLER: Retired or moved on, yeah.

DR. HILL: I see. And regarding the particular batch process research that you said was done here in the United States, where exactly was that conducted?

MR. HELLER: That was done both in Paterson and at the pilot facilities in Illinois.

DR. HILL: So there were batch processes developed at both of those sites, but --

MR. HELLER: I think the process was developed in Paterson, and then they tried it out in the pilot reactors in Illinois.

DR. HILL: But then when they went to production is when this change occurred, these series of changes that occurred, larger volumes and full batch rather than semi-batch.

MR. HELLER: Now, all of the pilot batches were also full batch.

DR. HILL: Oh, they were?

MR. HELLER: Yes.

DR. HILL: Okay.

DR. TAYLOR: Any other questions?

DR. HILL: Thank you.

DR. TAYLOR: Gerry, do you have any questions?

I have no questions on this section.

What we'd like to do now, we're pretty much on time. We'd like to take a 15 minute break. We will have public comments after we complete our presentations this morning or early afternoon. What I'd like, if there's anyone in the audience who has not signed up and you would like to make public comment, there is a table out front, outside the hallway here where you can sign up to do that, and we'll take a 15 minute break and come back at exactly 10:45.

(Whereupon, the foregoing matter went off the record at 10:31 a.m. and went back on the record at 10:45 a.m.)

DR. TAYLOR: I want to remind us, the Board members as well as the presenters, I was told during the break that it's very hard to hear in the back, particularly when you turn your heads away from the mic. So remember that, and they even said they couldn't hear me. So that's pretty good because I'm usually very vocal and people can usually hear me without a mic. So please speak in the mics.

We are reconvening now the Morton investigation report, and we will continue with Dave Heller.

MR. HELLER: All right. Thank you, Andrea.

I'd like to move now into discussion of

Morton's process safety management program. The CSB investigation focused on the following elements of the Morton program: process safety information, process hazards analysis, the previous batch history, management of change, operating procedures, and training.

First we'll talk about process safety information. As we noted earlier, the Morton facility was not aware of the presence of the decomposition reaction. The process safety information package which was used by the Paterson plant to design the production process in 1990 and served as the basis for the process hazards analysis conducted in 1995 noted the desired exothermic reaction to produce the Yellow 96, but did not include information on the undesired decomposition reaction. It did not contain details of the research performed in the United Kingdom, and it did not contain the recommendations made by the United Kingdom researchers regarding process safety and the control on any additional testing. It was all in that memo we noted from 1989.

There were two additional findings with regard to the process safety information package that I'd like to touch on. Morton's material safety data sheet for Yellow 96 stated that the National Fire

Protection Association or the NFPA reactivity hazard rating for this material was a zero, and that's on a zero to four scale with four being the most reactive.

The Chemical Safety Board has determined that the proper reactivity rating for yellow dye 96 is a one based on calculation method from the NFPA's Standard 704, which is their standard system for identification of hazards of materials for emergency response.

Now, the reactivity rating is a ranking of the degree of susceptibility of materials to energy release, and the NFPA defines zero materials as "materials that in themselves are normally stable even under fire conditions, while one materials are normally stable, but can become unstable at elevated temperatures and pressures."

Now, the ratings are used by emergency responders, as well as employees and customers, as an indicator for the degree of hazard associated with the chemical, and the NFPA also has a health and fire rating on the same zero to four scale.

Well, anyway, in our case we had a zero versus a one. Erroneous information regarding reactive hazards can result in errors in handling the materials or in responding to emergencies involving a given substance. In this incident, the different didn't enter into the emergency response activities.

Another point on the process safety information, Morton stated in their process -- in their material safety data sheets that Yellow 96 had a boiling point of 100 degrees Centigrade, and Chilworth determined that the atmospheric boiling point, in fact, was approximately 320 degrees Centigrade, and we wanted to note that that is well above the onset of the decomposition reaction, which was 195 degrees Centigrade.

Now, again, while not directly pertinent to the incident, these are examples of shortcomings in the information package. It could have contributed to the operators and supervisors' unawareness of the possible consequences of the process.

The next element is process hazards analysis. Now, process hazards analysis, or PHA, it's a structured, in-depth examination of potential hazards of a process in which you look at the hazards; you look at the consequences. You determine what existing safeguards you have in place to protect against those consequences, and on the basis of the differences between those consequences and the safeguards, you'll be able to see if you need to make recommendations to improve the process to make it safer, and those recommendations can be in the form of safety equipment, in the form of improved training, or changes in procedures, really the whole gamut of things that you can do to improve the process.

Now, the formal process hazards analysis for Yellow 96 was conducted in January of 1995. That was about four years after the first batch was produced at Paterson. The analysis was performed using the "what if" method. That's one of the accepted methods.

It was performed by a team. The team was plant employees, and it included an engineer, a chemist, a safety professional, and an operator.

The hazards analysis that was conducted for the Yellow 96 process did not address the consequences of important deviations, such as excessive heating, a runaway reaction, or the inability to provide enough cooling to maintain temperatures in a safe operating range.

Morton's process safety management program did not require that the PHA team, the process hazards analysis team, question the adequacy of relief device sizing. Consequently the reactor rupture disk was significantly undersized and unable to relieve the pressure generated during the incident.

Now, as noted earlier, the Paterson plant had received a number of memos from the pilot facility that indicated the potential for a thermal runaway in the Yellow 96 process. However, when PHA team asked the question, quote, "What if runaway reaction occurs?" end quote, the PHA team recorded the hazard and the consequences as "not applicable."

The team relied on the information from the pilot plant and the success of the pilot plant batches and the apparent success of the Paterson batches to reach this conclusion. The team did not take into consideration the potential for a runaway reaction, although the potential was evidence from the product development information.

Now, an effective process hazards analysis program requires deviations of examinations from normal operation that could turn an exothermic reaction, a controllable exothermic reaction, into a runaway situation. The PSM program should have required that the process hazards analysis team consider deviations like what if the ONCB is warmer than specified prior to the 2-EHA addition or what if the predetermined temperature ranges in the heat-up process cannot be met because of, say, an equipment an instrumentation malfunction.

The process hazards analysis did ask the question of what if the heating system failed, but they did not ask the more relevant question: what if there's inadequate cooling?

The Morton program did not require that the process hazards analysis team consider the potential ramifications of a number of high temperature excursions that had occurred in previous batches. Investigation of these incidents would have provided an opportunity to correct design problems. I'll talk more about these batches in a few minutes here.

And as a result of not recognizing the potential for a runaway, the team did not consider the need for additional safeguards, such as the ones recommended by the United Kingdom researchers in 1989.

Now, the late Frank P. Lees, who was an internationally recognized process safety expert, he stated with regard to emergency safety measures, quoting from his book, "There are a number of emergency measures that can be taken if a process deviation occurs which threatens to lead to a runaway reaction. The prime measures are inhibition of reaction, quenching of reaction, and dumping," end quote.

The United Kingdom recommendations of 1989 did suggest a quenching or controlled quenching of the reaction with water as an emergency safety measure. However, the measures that were actually used at Paterson, direct removal of heat and the full normal cooling, are not listed in the Lees publication as prime emergency safety measures.

Now, quenching with water may not have been appropriate given the fact that the process was being run above the boiling point of water and the condenser vents and the relief vents would have had to have been sized to take into account that generation of water vapor, of steam that would have been taking the heat out of the kettle, but again, this is an example of a possible safety improvement that should have been considered during the process design effort.

In the process hazard analysis, also, the team, again, did not question whether the relief device sizing was adequate. Now, effective process safety management programs require that the hazard analysis teams will hypothesize potential pressure relief scenarios, loss of cooling or loss of agitation or errors in the addition of the reactants, and those would be upset conditions or error conditions that result in the greatest amount of pressure generation and require the greatest pressure relief area, relief venting area.

The necessary venting area is then determined through laboratory testing and calculations, and scenarios such as these were not discussed during the Yellow 96 PHA. Instead, again, the team relied on the information they had received from the pilot plant that a runaway situation was not expected.

So as a result, the kettle's venting system was not designed to handle the pressure generation of the runaway reaction and had been sized instead for just the external fire scenario.

Now, after the incident, Morton themselves calculated in their analysis afterwards that a vent area of 116 square inches would have been required to properly vent the two-phased flow mixture that resulted from the decomposition reaction. On kettle K-7, the six inch rupture disks had a venting area of only 28 square inches.

Now, Morton did make user of the DIERS technology for this assessment of the relief requirements, and DIERS is Design Institute for Emergency Relief System. That's a consortium of companies working under the umbrella of American Institute of Chemical Engineers since 1976 to develop methods for the design of emergency relief systems to handle run-away reactions and two-phased flow.

I noted in the process hazard analysis that the team had not considered problems with previous batches. Now, a number of these batches had exhibited unexpected exothermic reactivity as seen by high temperature excursions beyond the normal operating range. There was an unusual temperature profile or the maximum operating temperature of 150 to 153 was exceeded in spite of the operator's efforts.

Now, in these batches, the temperature did return to the operating limits. Now, management did not investigate these warning events in the processing history, and did not consider these previous incidents during the PHA.

Some examples from batches, the operators would put their findings or what they observed during the batch on the batch sheet. So there was notes like, quote, "Cooling not controlling temperature," end quote, during one of the staged heat-ups. "Cooling inadequate to control temperature" during a hold step. On some of the batches, 14, 15, and 18, the temperature chart, this 150 degree chart, the temperature went past the 150 degrees. So it was off scale on some of the batches for 30 minutes, and for one batch up to 175 minutes, and again, 150 was about the upper temperature the operators were trying to control the batch at.

In 1995, the PHA was conducted. So you can see that in '95 there was information from all these high temperature batches that should have been used and should have been discussed in the process hazards analysis.

In 1996, starting with batch 25, Morton switched from 1,000 gallon kettles to 2,000 gallon reactors, and, again, that was to avoid color contamination between the batches, and there was even a higher frequency of events now in the larger kettles.

Batch 28 was in 1997. The operators noted on the batch sheet "cooling water of no use," end quote. And Batch 30 was a batch where the temperature went off the chart, and 31, which was in March of 1998, the batch just previous to the final Batch 32, again, the temperature went off the chart, and the operators from the digital readouts and in our interviews, they recall the temperature was 180 to up to 200 degrees on that batch. The temperature of cooling eventually caught up with it, and it came back down.

Now, the high temperatures observed by the operators were not always written on the batch sheets. They did not verbally inform the supervisors of excursions when the temperatures returned to normal limits, but the operators' written notes on the batch sheets detailed above and the temperature charts showing the temperatures greater than 150 should have served as notification to supervision of the temperature control problems and prompted management to follow up with the operators.

Several supervisors, indeed, were also aware that high temperatures had occurred in the past. Now, these temperature exceedences (phonetic) were considered a quality concern by management and not a safety concern.

The next element we'll talk about is management of change. Again, beginning with Batch 25 in '96, 1996, Paterson began producing the Yellow 96 in the 2,000 kettles versus the 1,000 they had used for the first 24 batches. And at that point they also scaled up the size of the material, the batch contents, by about nine percent.

The combination of these two changes affects the amount of -- again, the jacket surrounds the vessel, and when you go to a larger vessel and change the amount, it affects the amount of heat transfer area that is actually touching or surface, cooling surface, that's touching the wetted part or the part of the vessel below the liquid level inside.

And it was about a ten percent reduction in available heat transfer area per gallon of material after that change was made. So the batches in the 2,000 gallon kettles had less cooling per gallon of reacting material than the batches in the 1,000 gallon kettles.

Again, the fact that they were running very close to the runaway conditions, all of these batches that had high temperature excursions, it's even now less likely that the operators will be able to control the reaction in the larger kettles.

And, in fact, while 20 percent of the batches before in the 1,000 gallon kettles showed the high temperature exceedences, fully 50 percent of the six batches made after the change showed the high temperatures.

Now, Paterson did not use its management of change procedures to review the safety of these changes, even though they met the definition of a change in Paterson's process safety management program. These are the types of changes that are routinely done, reviewed at chemical plants.

The batch sheets also were never modified to reflect these changes, and the batch sheet -- again, one of the consequences of doing a management of change is you assess the consequences, and you take steps to protect against any consequences from that change, and you also update your information. You update your training, your procedures, and your drawings and such to reflect that change.

But the batch sheets in use in April '98 were last revised in 1996. They specified the use of the 1,000 gallon kettle, and the scaled up volumes is nine percent or ten percent/nine percent scale-up in the volume were indicated on the batch sheets by crossing out the old volumes and just writing in the new volumes.

The final two elements of process safety management that are relevant here are operating procedures and training, and we'll talk about those really kind of together. They're really related to each other.

The Yellow 96 batch sheet contained little guidance for the operators on how to manage the exothermic reaction between the ONCB and the 2-EHA, and as a result, each operator ran the process a little bit differently, and these differences combined in Batch 32 to produce the runaway reaction.

Potential consequences of this lack of

guidance included there was items in the batch sheets that said things like, quote, "Adjust the temperature of the kettle to 40 to 42 degrees with mixing," end quote, and the onset temperature was 38 degrees. Again, that lack of knowledge. The higher temperatures can lead to early initiation of the reaction and make it less likely for the operators to control.

The batch sheet stated carefully heat the batch to 90 degrees. "Do not overheat or batch will start to exotherm," end quote.

Another quote, "carefully give batch small shots of steam to raise the temperature two to three degrees if necessary," end quote.

And there are no instructions or training on how much steam to apply or how long to apply the steam. So, again, each operator had their own technique, and they were looking for different temperature milestones to determine when to switch from the steam to the cooling water.

Now, on Batch 32, the operators stated that they let the steam enter the jacket for about five to ten minutes with five pounds of steam on the jacket, pressure of steam. They did not apply the cooling water until the batch reached a temperature of 100 to 110 degrees.

This is somewhat contrary to the experience of the other operators who stated that the amount of steam emitted to the jacket should be minimal, lasting only one to five minutes, and that the cooling water should be applied when the batch temperature reached 70 to 80 degrees.

Now, a note on the final reaction step said, "Do not heat batch above 160 or yield and quality will be lower," end quote, and the operators and supervisors stated during interviews that they had not been trained regarding the risk of a runway exothermic reaction in this process. They believe that temperatures higher than the maximum of 160 would only result in quality problems in the finished products.

And, again, the temperature chart could only record up to 150. So as far as a history of the batch, that really limited Morton's ability to document the temperature profiles and to identify the abnormal temperature deviations.

So Batch 32, additional steam raised the reaction rate to a point where it was generating heat faster than it could be removed by the cooling water, and that's just an immediate cause or a direct cause of the event, but it really just highlights the circumstances under which the operators were being asked to run the process.

They knew the batch was sensitive to heat, but they were unaware that there was the potential for a runaway or a decomposition.

Plant operating procedures didn't really given them the guidance on how much heating or cooling to supply, and every operator was really using their own experience on the batch, and also on emergency procedures, the operating procedures did not address the handling of emergency situations in the kettles. The operators were not sufficiently trained to understand or react to this runaway situation. They were told to insure that there was full cooling water on, and they were really given no other instructions.

They were told to obtain help from their supervisors when unusual events occurred. So on the evening of the incident, the supervisor, two operators running the batch, and the other operators in the area stayed by the kettle while first rapidly rising temperature exceeded the upper operating procedure limit of 160.

Second, the residual 2-EHA started boiling and the reaction started generating additional gases.

Third, the violently boiling mixture is flooding the condenser.

Fourth, the ruptured disks actuate because of the pressure.

Fifth, the kettle is rumbling and shaking.

And finally, the kettle exceeds the decomposition temperature for -- the onset temperature for the decomposition reaction of 195 degrees.

And after the operators had established that the heating was off and the full cooling was on, but the temperature continued to go up, their presence really couldn't contribute anything to preventing an incident such as the one that occurred.

And now I'll break.

DR. TAYLOR: Okay. Any questions of Board members?

DR. HILL: Dave, you indicated that there were various notes along the way that operators had written on the batch sheets. Did they express a concern that, hey, this is a dangerous process or we're afraid that it might blow at any point and bring that to management's attention?

MR. HELLER: That was really only -- everybody was aware of the -- that it was very sensitive. That specific concern, I think, was only discussed in an interview with one operator.

DR. HILL: So nothing happened as a result of those notes being --

MR. HELLER: Again, yeah.

DR. HILL: -- just occurring over a period of time?

MR. HELLER: This was over the eight years they were making the product, and the notes were there on the batch which the supervisors were given after the completion of each batch.

DR. HILL: Okay, and I think you also said that the sheet for this particular batch, I believe it was Batch 32?

MR. HELLER: Right.

DR. HILL: The sheets were lost in the fire?

MR. HELLER: They were not recovered, right.

DR. HILL: Okay. Okay. Thank you. That's all.

DR. TAYLOR: I guess I wanted to follow up on Paul's question regarding the batched sheets. The temperature increases that were listed on the batch sheets were largely for quality control versus any reminder to or alerting the supervisor that there could have been a problem with safety?

MR. HELLER: Well, the temperature, the

high temperature of the 150, the top operating temperature, 160, the maximum that they warned about were considered a quality, but the way the operation worked is it started, heated up to 90, and then they'd slowly raise the temperature and let the reaction cook, if you will, at that temperature for a while, and then they'd raise it a little more and a little more.

That was really their means of trying to do it slowly and keep the heat from exceeding their --

DR. TAYLOR: And the supervisors nor the employees were aware of the potential danger that could occur.

MR. HELLER: Well, they knew it was exothermic. They knew that the reaction would start to take off. They'd all seen these batches where the temperature had gone very high, and fortunately the cooling water was brought on soon enough that it didn't really get to that big ramp up of the decomposition.

But they weren't aware that it could keep going.

DR. TAYLOR: Okay. Thank you.

DR. POJE: Dave, is there any evidence that was gathered about the particular operators and these excursions to indicate that they were unique to an operator, particularly the operator in this case?

MR. HELLER: I think most of the operators had experience of those events over the course of the years.

DR. POJE: And was there communication amongst the operators about such a problem that influenced each other's approach towards managing?

MR. HELLER: The training was pretty much on-the-job type training where an experienced operator would have a new guy and kind of walk them through a batch, and they'd do it together a few times to see, well, here's where I turn the temperature on, and here's where I switch to cooling water.

So it was that kind of training going on in the field.

DR. POJE: I mean, wouldn't it be correct to say that since concerns were already raised about the temperature went above 160, got yield and quality that went much lower than what you wanted to have, that it was, in fact, an understanding that there was a decomposition occurring here; that it was a temperature higher than the normal range? You're not getting the product that you need to have. You're getting something else, and it obviously is something that is degraded from your intended, desired reaction.

MR. HELLER: Yeah, there could have been, but there's -- yeah, the high temperature could have caused problems with the chemicals, and obviously there were reactions occurring, but I don't think the --

DR. POJE: But not formalized.

MR. HELLER: It was never really formal. They never put two and two together, that maybe these quality problems were the precursors for the big decomposition.

DR. POJE: And just to clarify one additional point, you identified a number of situations that would have fallen into the Morton Paterson facility's management of change requirements, the change from 1,000 to 2,000 gallon vessel, the change in batch size, the change in heat transfer rate.

From your experience and the team investigating this's experiences, you're saying that these are common threshold activities that would initiate formal management of change review procedures commonly throughout the industry.

MR. HELLER: That would be common throughout the industry. In fact, in interviews, the Paterson management said, "Yeah, we should have reviewed that change, those changes."

DR. POJE: And then just one more point to clarify. You talked a little bit about the NFPA ratings, particularly the change from zero to one, but in the instance of understanding the reactive chemistry problems in a vessel, the NFPA ratings in and of themselves are not sufficient to tell you about the reactive chemical conditions that you're likely to have.

NFPA is --

MR. HELLER: Right. The NFP --

DR. POJE: -- with fire in an ambient pressure, an open pressure situation.

MR. HELLER: Exactly right.

DR. POJE: Or ambient temperatures, and here we have very different conditions that chemicals are being placed under.

MR. HELLER: The NFPA in their standards and 704 and 409 where they list a lot of the chemicals, they state in there that these ratings are for use by emergency responders, fire fighters in assessing.

Again, the thing is that you come up to a tank and there's a fire, and the NFPA system is a large diamond, and there's a blue area for health and a red area for fire and a yellow area for reactivity. I might have the colors wrong, but it's on the side of the tank.

So the fire fighter comes up there, and he can see this tank has a big W on it with a line through it. That means it's reactive with water, or it has a three or a four. It's very reactive or it's very flammable, and that's their notice to back off or to reconsider their tactics.

DR. TAYLOR: Thank you.

You can continue.

MR. HELLER: Okay. Finally, I'd like to talk about the regulatory aspects of the process safety management as it pertains to the management of reactive chemical hazards at Morton and in the chemical process industry in general.

OSHA's process safety management standard did not contribute directly to causing this incident. However, OSHA's process safety management standard establishes only minimum requirements on process safety management. Additional guidance would likely have caused the Morton-Paterson staff to recognize the hazards of the '96 process and taken steps to avoid the incident.

OSHA process safety management standard, again, did not cover the '96 process. Coverage is determined on a per process based on the chemicals used in that process.

However, Morton did include the process

under their internal process safety management program which applied to the OSHA regulated processes and certain other processes. In most respects NHTSA patterned its program after the OSHA standard. However, there were significant emissions and differences.

Also, the Morton program did not require adherence to a number of industry good practices for the safe management of reactive chemical processes.

Now, the OSHA standard, the process safety management standard, only refers to reactive chemicals and reactive chemical hazards in describing the types of process safety information that's required for a process, the reactivity, the thermal information, the stability information and such.

And the OSHA process safety management standard covers chemicals that are ranked threes and fours under the NFPA's reactivity rating. Again, that was the zero to four system, with four being the highest.

The PSM standard covers all flammable materials which are materials that are formally defined with a flash point below 100 degrees Fahrenheit, and it covers a little more than 100 other materials that are toxic or reactive.

The Environmental Protection Agency's risk management plan program for reactive chemicals does not cover reactive chemicals as a class. Some reactives are covered because they qualify for inclusion because of their other properties. Either they're toxic or they're flammable.

Now, in the past, safety guidelines have been issued by OSHA and EPA, and they have been used extensively by industry. One great example is the EPA's off-site consequence analysis guidance, and that was developed for use by industry to comply with the risk management program requirements.

More recently, books such as Lees' Loss Prevention in the Process Industries and the United Kingdom Health and Safety Executive, again, U.K.'s equivalent of OSHA, they have recently published a book called Designing and Operating Safe Chemical Reaction Processes that are available with a lot of specific information.

We've brought several copies of that HSE booklet with us here today, and if you have an opportunity after the presentation, please take a look at those. They're available from the Health and Safety Executive's Web site.

With respect to Paterson's process safety management program now, some of the shortcomings included the following.

Under the requirements for what a PHA should address, the Morton program did not include OSHA's requirement for identification of any previous incident which had a likely potential for catastrophic consequences in the work place. An investigation of these occurrences would have provided an opportunity to correct design problems which likely would have prevented the incident.

An operating procedure is required for emergency shutdowns, and Morton's programs simply list emergency shutdown in a list of required procedures and omits OSHA's requirements under emergency shutdown, that the procedure should state the conditions under which a shutdown is required, and what are the operator's responsibilities.

Again, inclusion of this information in the training and the operating procedures might have caused the operators to evacuate sooner.

There were also some inadequacies in Morton's implementation of its process safety management program. The Morton program required that the process safety information package contain copies of laboratory work, pilot plant work, and other testing, including anything performed outside the company that pertains to the hazards posed by the chemicals using the process, and it required information on kinetic data for important reactions, process reactions, and undesirable reactions, and they do say in their internal standards "such as decompositions."

Again, as we said in the process safety information sections, there were a number of memos and notes that touched on the exothermic nature of the process, but the testing results and the memos that explicitly discuss the runaway were not provided to the PHA team or used to inform the operating personnel.

And also the change from the 1,000 to 2,000 gallon kettles was not approved through the Morton management of change process, and again, here Morton missed an opportunity to assess the hazards of the process and take steps to avoid an incident.

Finally, we'd like to relate the Morton event to some other recent catastrophic events in the -- reactive chemical events -- in the industry. Incident databases, such as the EPA's emergency response notification system and OSHA's incidence statistics, contain upwards of 30 events in the last decade that were characterized by key words, such as exothermic reaction or runaway reaction, and two of the serious events of this type were the Napp incident and the Georgia Pacific incident.

Of course, the Napp explosion and fire in Lodi, New Jersey on April 21st of 1995, there were five deaths, as well as injuries, evacuations, and serious damage on an off site.

And according to the EPA-OSHA report on the incident, the most likely cause of the incident was the inadvertent introduction of water into water reactive materials, in this case aluminum powder and sodium hydrosulfite during a mixing operation, and it resulted in a runaway reaction.

And as in the Morton case, the chemicals and the chemical reactions involved in the Napp incident were not covered under the OSHA process safety management standard.

In late 1995, OSHA received a petition to promulgate an emergency temporary standard as a result of the Napp incident, and the purpose of the petition was to expand the list of chemicals covered by the PSM standard, and as of July 2000, as of our meeting here today, OSHA has not acted on this petition.

The second incident was an explosion in 1997 in Columbus, Ohio, at the Georgia Pacific Resins, Incorporated, and that killed one worker and injured four others. This explosion was also caused by a runaway reaction.

As detailed in the EPA chemical safety case study on this incident, the runaway was triggered when, contrary to standard operating procedures, all the raw materials and catalysts were charged through the reactor at once, followed by the addition of heat, and under the runaway conditions, heat generated exceeded the cooling capacity of this system, and the pressure generated could not be vented through the emergency relief system, causing the reactor to explode.

On the Georgia Pacific event, the PHA that had been conducted, the process hazards analysis, had not considered the failure to control the rate of chemical addition, and the pressure relief system was not sized to handle the pressure rise from such an event.

Morton, Napp, and Georgia Pacific were three of the most significant and highly studied reactor chemical incidents in the United States in recent years. Again, there are others, as I noted just a minute ago.

At this point, again, are there any questions on the regulatory issues?

DR. HILL: Yes, Dave. You testified that basically, although Morton at this facility was making a concerted effort to apply a process hazards analysis to this particular process, it wasn't required, but that that process was somehow deficient, was rather deficient in some areas of not looking particularly where problems may have indicated they had surfaced basically by using a more thorough process. Is that correct?

MR. HELLER: The process was not covered by the OSHA process safety management standard. Morton did cover it by their internal process safety management standard. Many times when companies have a mix of -- especially in a batch plant -- a mix of processes that are covered or not covered, they will cover them all just so everything gets that same type of exposure, same type of analysis.

DR. HILL: I think you also said that that's standard industry practice.

MR. HELLER: Pretty much.

DR. HILL: Good practice. You also indicated that the notes were made on the bad sheets about temperature excursions. Was there any evidence that you uncovered during this investigation that there were any other indicators of any type that may have led anyone at the facility to be alarmed about this situation?

I mean, were there any small fires or venting activities or anything that would have been an alarm basically?

MR. HELLER: No, we're not aware of anything other than the batch sheets and then the temperature charts, the circular chart were stapled to the batch sheets for each batch, and again, they would have showed that they had pegged out or maximized the chart reading at 150 degrees on those several batches.

DR. HILL: Thank you.

That's all.

DR. POJE: Dave, you mentioned good management practices in a number of arenas here. Do you have any sense of good management practice in the auditing and updating of process safety information packages or in reviews of process hazard analyses that would put us into a more accelerated incorporation of newer knowledge or more recent knowledge about process deficits?

MR. HELLER: The good practices, you develop the process safety information package as the process is developing. So on the bench scale, you have little information, and as you do the testing, you do your thermodynamic testing. That package grows; you learn more about the process.

OSHA requires before you do the process hazards analysis that you have the full process safety information package. There's probably 15, 20 specific items that are required on that list of process safety information.

DR. POJE: But as new information is gathered in the real production process either at the 1,000 gallon or 2,000 gallon level and you have these excursions occurring, at what point in time does it trigger a new understanding of the hazards of the operation, as well as perhaps the generation, as was stated earlier, of better information in a process safety information package?

MR. HELLER: The high temperature excursions were an opportunity to determine what went wrong and do an investigation and see what were the circumstances and was it a one time event or was there something systemic in the equipment or in their systems.

The management of change, again, was another opportunity to update their information and do that sort of analysis.

DR. POJE: And while most of our

investigation focused in on the production of automate Yellow 96 dye and the batches associated with that, one presumes that there is a multitude of dyes and other chemicals being produced at this facility. Was there any investigation conducted to look at other processes that may have had similar deficiencies?

MR. HELLER: This was apparently one of the more energetic processes at the site. I'm not really aware from my point of view of any other investigations that were done.

DR. TAYLOR: Dave, I have a question going back to the OSHA PSM standard. Now, under process safety information, companies are required to list the hazardous effects of inadvertent mixing of different materials.

MR. HELLER: Right.

DR. TAYLOR: So even though OSHA includes the NFPA of three and fours for rating chemicals for reactivity and these were zeros or --

MR. HELLER: Yeah, zeros and ones,yeah.

DR. TAYLOR: And ones. Had there been enough analysis conducted, would the mixing have been identified as covered under OSHA PSM?

MR. HELLER: There's a difference between what you're talking about as inadvertent mixing.

DR. TAYLOR: Okay, all right.

MR. HELLER: What OSHA means there is if you put the wrong material in the kettle. This was the desired reaction, the ONCB and the 2-EHA. Typically for inadvertent mixing, you do what you call a reactivity grid where you take everything in your building, and it's like a map, a mileage chart on a map where you have all of the places on one side and the other side you take the intersection to see what happens.

You do that for all the combinations of chemicals, and it helps you decide maybe I need to store these away from each other or make sure we have better labeling.

But, again, this was the desired reaction, not an inadvertent reaction.

DR. TAYLOR: Okay. Any other questions?

(No response.)

DR. TAYLOR: Thank you, Dave.

MR. HELLER: Okay. Bill Hoyle is now going to summarize our determination of root causes and the contributing causes, and he will be then presenting our proposed recommendations.

MR. HOYLE: Good morning. I'm Bill Hoyle. I'm the Director of Investigations and Safety Programs for the Chemical Safety Board, and it's my pleasure to join you. It's still before noon, so I'm glad about that.

I want to recap briefly, review the root and contributing causes of the incident, which Dave outlined at the beginning of the presentation, to review those in preparation for presentation of our recommendations.

First root cause is that neither the preliminary hazard assessments conducted by Morton in Paterson during the design phase in 1989, nor the formal process hazard analysis conducted in 1995 addressed the reactive hazards of the Yellow 96 process.

This had the following results, as has already been reported, that the cooling capacity of the kettle was not appropriate for the process that it was being produced in that kettle.

The kettle was not equipped with a quench or an emergency reactor dump system, which would have likely prevented the explosion.

The height, emergency pressure relief device, the rupture disk, was not properly sized. If it had been sized properly, that also may have avoided the catastrophic event.

And then in addition, procedures as Dave has outlined. Procedures didn't address safe control of the process or give guidance to personnel of when was it time to evacuate and leave the building.

It is possible that they still could have had the runaway reaction, but that personnel could have evacuated the building in advance with proper training.

Next root cause, process safety information provided to plant operations personnel and the team doing the formal process hazard analysis did not warn them of the potential for a dangerous runaway chemical reaction. As has been reported here, Morton's own researchers had documented the problems, concerns with the exothermic reaction, and the need for further research, further testing, and further safety measures, but these were not acted upon.

At the facility operators and supervisors were unaware that a dangerous, undesired decomposition reaction was possible.

A third root cause, process development did not address important aspects of the reactive hazards of this process. In particular, in the process development work they changed from a staged addition or semi-batch process to a staged heating batched process, and they did not adequately address the increased hazards of this change.

The change resulted in providing operators with less opportunity and less margin of safety in the manufacturer of the material.

I need to step back a moment. I wanted to preface my discussion of the root causes with a brief definition of what we mean by use of the term "root cause." It's one that's used commonly, but we're using it to mean something in particular at the Chemical Safety Board.

And by root cause, we mean those prime and underlying causes that resulted in a catastrophic chemical incident, and that further we have two qualifiers on that. First, that in our vision, there are virtually always multiple root causes. There is rarely one root cause.

And then lastly, we find that root causes almost always are found or involve problems in management safety systems. In other words, an operator error is typically involved or often involved in any major chemical incident, but it's rarely a root cause. It's a symptom of an underlying problem in management systems, as has been outlined today in the analysis presented.

Now I want to move on to the category of contributing causes. These are things that we also found causal to the incident, but not rising as high in significance as those that we outlined as root causes.

First, the hazards of operational deviations were not evaluated. Management did not investigate the evidence from prior batches of trouble. If that had been investigated, it likely would have provided the opportunity to take measures that would have prevented the catastrophic event that happened in 1998.

And lastly, Morton did not follow their management of change procedure to review changes made in the size of the reaction kettle and the size of the batch, and that's pretty self-explanatory.

Now I want to move to our investigations, and I want to preface this by saying we have a number of recommendations to various organizations, and they include the following: Morton International, the Morton Paterson facility, the EPA, OSHA, and also there will be various organizations that we want to have help share information about this report, and I'll explain that in a moment.

So the first recommendation is to Morton International, Incorporated. This is the parent company of the Morton Paterson facility, and the recommendation is to establish a program to insure that reactive chemical process safety information is shared with all relevant units of the company.

In this particular incident, important safety information about reactive hazards was identified by company researchers in the United Kingdom, but this information was not made known to Paterson plant personnel who needed the information in order to safely operate the process.

The next five recommendations are directed to the Morton Paterson facility itself. First, revalidate process hazard analyses for all reactive chemical processes in light of the findings of the CSB report and upgrade as needed equipment, operating procedures, and training.

In this incident the process hazard analysis that was conducted failed to identify the potential for a dangerous runaway reaction. As has been explained, this resulted in serious design deficiencies, as well as safety procedure problems and other problems that have been reported on.

Next, evaluate pressure relief requirements for all reaction vessels using appropriate technology, such as the Design Institute for Emergency Relief Systems, DIERS; method and test apparatus; and upgrade equipment as needed.

As already reported by Dave Heller, the high pressure emergency relief device in the kettle was much, much smaller than was needed to safely vent the kettle in the event of a runaway reaction.

The next recommendation to Morton is to evaluate the need for, and install as necessary, devices such as alarms, added safety instrumentation, and quench or reactor dump systems to safely handle reactive chemical process hazards.

As we've reported, in this incident the equipment, the process kettle, was not equipped with a quench or reactor dump system. If it had been so equipped, it is likely that it would have prevented the catastrophic event.

Next, revise operating procedures and training for reactive chemical processes, as needed, to include descriptions of the possible consequences of deviations from normal operations and steps that should be taken to correct these deviations, as well as emergency response actions.

In this incident, the company procedures and training did not warn personnel of the possibility and the dangers of the runaway reaction. Training and procedures should have directed personnel to evacuate the building once the process became uncontrollable, and that an explosion was likely.

And next, to the Morton Paterson facility, implement a program to insure that deviations from normal operational limits for reactive chemical processes that could have resulted in significant incidents are documented, investigated, and necessary safety improvements are implemented.

As has been reported here, there are a number of previous batches. Normal process temperatures were exceeded. They were documented, and the investigation of these near miss type of events could have provided the opportunity to identify design and procedure problems and to correct those problems prior to experiencing a catastrophic incident.

The next two recommendations are made to both OSHA and the EPA. First, it is recommended that OSHA and EPA issue joint guidelines on good practices for handling reactive chemical process hazards, and that they insure that these guidelines, at a minimum, address the following:

First, the evaluation of reactive hazards and consequences of reasonably foreseeable and worst case deviations;

Second, reporting and investigating

significant deviations from normal operating limits;

Third, determination of pressure relief capability, emergency cooling, process controls, alarms, safety interlocks, as well as other good practice design features;

And, last, appropriate use of chemical screening tools, such as differential scanning calorimetry.

In the course of the CSB's investigation of this incident, we examined the guidance provided by OSHA and EPA to companies that handle manufacture, involved in reactive chemical process operations, and we found that these safety agencies provide very few specific guidelines for reactive chemical safety.

Issuance of such guidelines by these primary government chemical safety agencies, while not having the force of law, would be still a significant step forward in improving reactive chemical process safety.

It has been reported here, for example, that the Health Safety Executive in the United Kingdom, a sister organization, similar organization to EPA and OSHA, has just recently published a booklet with guidelines that would be very valuable.

I should also point out that the way that the HSC developed those guidelines was in partnership between government, industry, and organized labor actively participating in the creation of those guidelines.

The next recommendation is again to OSHA and EPA, and it's that they participate in a hazard investigation of reactive chemical process safety to be conducted by the CSB. The objectives of the hazard investigation would include the following:

First, a determination of the frequency and severity of reactive chemical process incidents;

Second, an examination of how industry, OSHA, and EPA are addressing reactive chemical hazards;

Third, an analysis of the effectiveness of industry and OSHA use of the NFPA reactivity rating system for process safety management purposes;

And, lastly, development of recommendations for reducing the number and the severity of reactive chemical incidents.

I need to take a moment to explain what we mean by the term "hazard investigation." It may be new to those who are in attendance today.

A CSB hazard investigation differs from an investigation of a particular incident. A hazard investigation examines a particular hazard, such as reactive chemical process operations. A hazard investigation of reactive chemical process operations would include an examination of a number of different incidents involving reactive chemicals and would identify common elements involved in these incidents.

A CSB hazard investigation would make specific recommendations to improve reactive chemical safety. In short, let me add further that the proposed hazard investigation is very similar to something called a special investigation, which is conducted by the National Transportation Safety Board. From time to time the NTSB looks at a safety problem or a general safety problem and/or a series of potentially related incidents in a special investigation, and then they develop recommendations.

Most recently the NTSB was interested in the issue of bus safety, and so they did a special investigation where they looked at, I believe, 40-some bus accidents to see if they could draw common conclusions and to make recommendations for improving safety.

So this is an additional activity that we think is important and that will have a big benefit for improving process safety involving reactive chemical operations.

And the final recommendation. The final recommendation is to the American Chemistry Council, formerly known as the Chemical Manufacturers Association, to the Center for Chemical Process Safety, CCPS, to the Paper, Allied Industrial, Chemical and Energy Workers International Union, PACE, and to the Synthetic, Organic, Chemical Manufacturers Association, SOCMA.

And the recommendation is that they communicate the findings of this report to their memberships.

One may wonder why are we making recommendations to these organizations. Well, an important part of the CSB's mission is an educational one, and part of that education is the dissemination of the lessons that are learned from investigation reports like this one of the Morton incident.

And so one aspect of our recommendations program is to recommend to key organizations who are particularly well situated to get the information out and to transmit the lessons learned to those that need to learn it, to make recommendations to them to share the information with their members. So that's the reason that we make recommendations of this type.

That concludes the presentation of the

staff to the Board, and we would entertain any questions.

DR. TAYLOR: Thank you, Bill.

I have one question regarding recommendations to OSHA and EPA. Why not a recommendation on rulemaking?

(Applause.)

MR. HOYLE: Okay. You're popular. We'll see if I am.

(Laughter.)

MR. HOYLE: Well, I think there's a number of things to think about in that question. As was reported by Dave Heller, we are aware of the emergency petition to expand the PSM standard to include more reactive chemicals, which was delivered to OSHA in 1995, but which has not been acted upon by OSHA at this date.

Let me say that it is unusual for the findings of an investigation of just one incident to be sufficient to recommend new federal rulemaking. It's not impossible, but it is unusual.

And as has been reported here, the CSB is aware of a number of significant incidents in recent years that have involved reactive chemical process operations. Dave mentioned a couple of those, but there are others that are even more recent where common lessons may be derived to make for a more powerful recommendation, to make even further steps forward for reactive chemical process safety.

Of course, we're all familiar with the Lodi incident, but there have been a number subsequent to that, in addition to Morton. So the recommendation, in my view, for CSB hazard investigation, as defined as a special investigation, it's what we call a hazard investigation. I think that will provide a powerful and excellent opportunity to examine this whole range of reactive chemical incidents that we are aware of, and to identify possible common causes and problems that may be associated with those incidents.

And I think that the proposed hazard investigation would serve as a very good basis for looking at a whole range of recommendations, and I think one of those recommendations could include the possibility of the need for rulemaking by OSHA to address reactive chemical safety in a different way or in a more effective way.

So that's the thinking of the staff on not recommending out of this particular incident investigation rulemaking from OSHA, but that the hazard evaluation -- that that would be something that would be a part, an important part of that investigation.

DR. HILL: Thank you, Bill, and thanks to the rest of the staff for presenting us with this information today. Obviously these recommendations, as Dr. Taylor pointed out early on, must be considered and weighed by the Board before we act on to implement them or modify or whatever, as she indicated, but I have to ask the basic question, and that is, indeed: do you feel, does the team feel, that if these recommendations were implemented, would the Morton case, this case we're looking at today, have been avoided?

MR. HOYLE: Well, absolutely, on the staff's part. If the recommendations that are made to Morton that have been outlined here had been in place, yes, they would. They would have likely prevented this catastrophic incident from 1998, and in addition, we think they also would help to prevent a whole range of similar possible incidents in their operation.

So we think it addresses the particulars of that one incident, and simultaneously would be a significant improvement in their safety operations that would be related to what took place in that incident.

DR. HILL: Thank you.

DR. POJE: Well, one of the broader recommendations is the one to OSHA and EPA about the issuance of joint guidelines for a good practice on handling reactive chemicals. Is there any evidence that would indicate the HSE or the Health Safety Executive's efforts are paying off with improvements of safety based upon their guidance, or is it too soon to evaluate that?

MR. HOYLE: In actuality, the HSE, newly published booklet on reactive chemical guidelines was just published in May, in May. So it's just a few weeks old. So there hasn't been time to ascertain that yet. It's just too soon.

DR. POJE: And I'm also impressed by the linkages between the evidence train that Dave Heller and Richard presented and the linkages to root and contributing causation and the flow of recommendations from that.

There's one area that I'm still a little bit hazy about. How would the recommendations address the absence of relevant process safety information on thermal analytical data that was absent in this case?

In other words, the recommendation had been that additional work be done. Is the recommendation to Morton International the one that would likely cover gathering additional process safety information for all reactive hazards within their domain, or is it the revalidation of PHAs that would likely generate such additional information?

I would like the staff to look at that closely because that is a key piece of evidence that was examined in this case, and I'd want to make sure that our recommendations put a lock on that issue as well.

MR. HOYLE: Okay. I think that staff will take that under consideration.

DR. TAYLOR: Any other questions?

(No response.)

DR. TAYLOR: Thank you.

Let me thank the staff for a very thorough presentation and, more importantly, for their hard work to get to this point. Thank you.

Some of you in the audience here may feel that since Rohm and Haas no longer produces automate Yellow 96 dye this investigation is now beside the point. In my opinion, however, the issue of reactive chemical accidents is an important one now and in the future.

The Board is concerned that runaway chemical reactions are responsible not only for the Morton and Lodi explosions, but also for a number of other serious accidents in recent years.

The area of reactive chemical hazards may, in fact, become the subject of a future Board hazard investigation. The Board follows with keen interest OSHA and EPA's activities in the area of reactive chemical hazards, and we urge those agencies to study the Morton report if and when we approve and issue it.

The Board also notes that overseas authorities, such as the British Health and Safety Executive, have recently issued good practice guidelines covering the use of reactive chemicals. Let me reiterate that nothing from today's presentation to the Board should be viewed as conclusive until the Board has had the opportunity to review and vote on the written report of the staff.

I will now recognize the staff representatives from the New Jersey congressional delegation for any statements or remarks they may have.

I'd ask that you approach the podium in the front here and give us your name and your affiliation, please.

MR. FLYNN: Good afternoon. I'm Mike Flynn from the Officer of Senator Robert Toricelli. I'm his Director of Intergovernmental Affairs and resident of Paterson.

And I'd just like to read a statement from the Senator.

"I appreciate the U.S. Chemical Safety Board holding the public review of findings here in Paterson, the site of the April 1998 explosion at the Morton Specialty Chemicals Paterson, New Jersey facility.

"The citizens of New Jersey I represent have a significant interest in the safety of the chemical industry and other businesses, especially with regard to the environment and public health.

"First, let me thank the United States Chemical Safety and Hazard Investigation Board for being so responsive to the situation at the Morton facility. Today is a testament to your good faith and diligence. The work you have done will contribute to safe operations and accident prevention, as well as to help improve the safety of chemical processes.

"I would also like to acknowledge the work of the Passaic County Board of Freeholders, the Passaic County Central Labor Council and PACE for their work in Hazardous Prevention Act which creates a special committee to give local citizens a vehicle for addressing complaints about noise, hazardous waste, and other industrial irritants.

"On the evening of April 8th, 1998, a

violent explosion occurred at the Morton plant injuring nine workers and releasing potentially hazardous chemicals into the neighboring community. The explosion and fire were the consequence of a runaway reaction which over pressured a 2,000 gallon capacity chemical reactor vessel. The resulting fire took over three hours to control.

"Far from being an isolated incident in the United States, chemical accidents occur regularly. In fact, there are at least 100 serious chemical accidents at fixed facilities in the U.S. each year. Indeed, who can forget of the accident that occurred at Napp Technologies in Lodi, New Jersey on April 21st, 1995, which claimed five lives and injured many more?

"These accidents result in approximately $1 billion worth of insured property losses each year, with total losses being significantly higher.

"Let me make it clear that catastrophes such as this affecting workers, families, and entire communities must be prevented from ever happening again. Citizens of New Jersey should never have to question the safety of the businesses in their communities.

"At the same time, businesses may improve consumer confidence in their products by insuring the safety of their manufacturing processes. I believe that we can insure a safe and health environment for our communities, while also insuring a healthy economy. They do not need to be mutually exclusive.

"That being said, I wholeheartedly support the investigators' proposed recommendations. While acceptance of these recommendations would go a long way towards insuring environmental health and public safety, we must do more in other areas, as well. For instance, in 1997 alone over 11,000 environmental enforcement actions had to be taken at the state and federal levels.

"Sadly, it is also becoming much more common for the defendants in these actions to be repeat violators. In 1994, a chemical company in New Jersey was fined $6,000 for environmental violations. Just four years later, the same chemical company was again cited for an environmental crime, but this time 53 children and five adults had to be hospitalized, and the EPA had to evacuate the local community.

"Incidents such as this are becoming all too common. Under current law, the penalties for repeat environmental violators or parties responsible for environmental catastrophes resulting in serious injury are inappropriately low. Indeed, paltry fines are insufficient deterrence for large corporations or parties that repeatedly commit environmental crimes.

"Between 1994 and 1998, New Jersey had 774 repeat violators, more than any other state in the nation. During that same period, more than 5,500 repeat violator facilities around the nation were prosecuted, with more than 700 substances identified by the EPA as hazardous. This lack of deterrence has serious repercussions for the environment and public health.

"In reaction to this and other cases like this, I will soon introduce Zero Tolerance for Repeat Polluters Act of 2000. This legislation will create stiffer penalties for repeat violators of environmental safeguards, and provides penalties that will more accurately reflect the cost to public health and the environment for catastrophic events.

"The bill will also give the EPA emergency order and civil action authority to address imminent and substantial endangerments of health and environment, and creates a new EPA trust fund into which recovered funds can be used to address other significant threats.

"Catastrophes such as the events at Napp Technologies and Morton Specialty Chemical can be prevented through increased vigilance and improved prevention techniques. However, repeat environmental polluters that negligently endanger the public with their actions or inactions should not be tolerated. No business should be able to endanger the public's health and safety with only the threat of a slap on the wrist hanging over them.

"I want to thank you again for allowing me the opportunity to be heard on this issue. I look forward to working closely with the U.S. Chemical Safety Board in the future."

Thank you.

DR. TAYLOR: Thank you, Mr. Flynn, on behalf of Senator Toricelli.

Are there any other congressional representatives in the audience?

MR. ROSEN: Good afternoon. My name is John Rosen. I'm here representing United States Senator Frank Lautenberg.

And I'd like to thank the Board for this opportunity to present some remarks in his behalf.

"I welcome the U.S. Chemical Safety and Hazard Investigation Board to New Jersey and regret that the congressional schedule does not allow me to attend in person.

"I visited the Morton Specialty Chemical facility shortly after the tragic explosion in April 1998. So I am especially glad to see the Board nearing completion of this investigation.

"No state stands to gain more from an effective Chemical Safety Board than New Jersey. The chemical industry is very important to the economy of our state. With hundreds of chemical plants in New Jersey, many of them directly abutting residential neighborhoods, schools, shopping areas, busy transportation routes, and other places where many people are found, a safe chemical industry is of extreme importance to all of us.

"That is why I fought to have the Board funded for the first time two years ago and have advocated for their funding ever since.

"The Chemical Safety Board has a unique role in promoting chemical safety. The Board is neither a regulatory agency, nor a mere reporter of superficial observations. Rather, the Board is an independent agency of the federal government whose job is to dig deep and to identify the root causes of our most serious chemical incidents, and to recommend the measures necessary to prevent them.

"As we have heard today, the Board's

recommendations can go to government agencies and private companies alike, and can address a wide range of topics. The Board's previous accident reports have been widely acclaimed, and I look forward to a Morton explosion report that will be just as illuminating and as effective in preventing future such tragedies in New Jersey and elsewhere.

"Thank you."

DR. TAYLOR: Thank you, Mr. Rosen on behalf of Senator Lautenberg.

Are there any other congressional representatives?

(No response.)

DR. TAYLOR: If not, on behalf of the Board, we certainly do appreciate the strong interest of members of Congress in this undertaking.

I will now invite, and we're going to lunch, as you can tell, and hopefully you'll stick with us. Maybe the comments will be a little bit brief.

We will go through lunch to see how much time we have for out public comment. Please abide by the same guidelines as did the Board members. Kindly limit your comments to five minutes and restrict the subject area to the case at hand.

I'd ask that when you approach the podium that you also state your name and your affiliation.

Do I have a list of the names?

Hold on. We're going to take a ten minute break before we start. I've been requested from a Board member that we take a short break. Let's make it five. Five minutes, is that good? Okay.

(Whereupon, the foregoing matter went off the record at 12:06 p.m. and went back on the record at 12:15 p.m.)

DR. TAYLOR: Okay. If everyone can take their seats, please, again, I'd like to mention that this is the public comment period, and if you can please hold your comments to five minutes.

We have two members of city council on our list, and before I call everyone else, I'd like to ask if the city council person, Jeffrey Jones, if he's in the audience. The councilman, Jeff Jones?

(No response.)

DR. TAYLOR: He's not here. Okay. What about Congress person Gau (phonetic), Council Person or Council Woman Gau?

(No response.)

DR. TAYLOR: Neither are here right now. So we'll go through our list.

I'd like to call Mark Dubzic, please.

PARTICIPANT: (Inaudible.)

DR. TAYLOR: Okay. Glenn Erwin.

MR. ERWIN: My name is Glenn Erwin, and I'm (inaudible) Coordinator for PACE International Union.

I spent about 30 years working in the Amoco organization in the oil and petrochemical industry on the Gulf Coast before assuming this position as the Health and Safety Coordinator for the union.

My principal job right now is to investigate major catastrophic incidents within the oil and chemical industry for PACE Union. I have been the lead person on the ground in the most recent one in Phillips 66 in Houston Texas.

I've also reviewed the -- we've had two incidences at Phillips, one in June of '99, another one in March the 27th of 2000. I reviewed the other in June of '99, along with what information we've had on the Morton explosion here and the Napp industry and the Georgia Pacific, and I find that there's many similarities.

They're almost to a point that you can overlay with transparencies the problems that existed within these different companies, and I submit to you that had early action been taken on the Napp energy or even the recommendations that's been laid out here today, had they have been already in place, the two incidents at Phillips would not have taken place.

I think the Board has done a very good job, and I think the recommendations are very good.

I do want to tell you some golden threads that tend to weave all of these incidents together. I know that the Board has not investigated the Phillips incidents, but I'd like to take just a couple of minutes and give you some highlights of that one, if you don't mind.

First of all, we found that there's insufficient institutional knowledge of the hazards associated with reactives that chemical plants are using today.

Another item -- well, that's highlighted in this case. That's also highlighted in the Phillips cases. They just didn't know the hazards of the material they was dealing with or what could possibly happen.

The next thing is there's a lack of interlock systems to prevent incorrect blending of amounts or incorrect blending of temperatures. These are active controls, things that would present if you flowed too warm of a temperature into a vessel, that would keep you from putting the other material in there.

There's active interlocks that can be in place in all of the facilities that will prevent this type of injuries.

The next thing is passive actions, passive controls, such as procedures that will prevent human error or blending amounts or temperatures or other error likely situations, as was caused in this one.

There's also a lack of adequate equipment to monitor or measure the pressures. You know, I found in some of these incidents they did not even have on vessels that contained reactive materials pressure indicators or temperature indicators or even flow indicators flowing amounts into it.

So it's a very critical thing within the industry that we do not have even sufficient information on what's going on.

Another thing that's very important is I find that there's a lack of investigative programs or techniques. Every fatality or major incident, these included, had they have investigated their near miss or lesser incidents and have implemented corrective actions, these that we're looking at would not have happened.

And if by chance they've done a decent

investigation, more than often the recommendations are not followed up on in a timely manner to make the corrective action.

If a PHA was completed on equipment that blew up, odds are on every one of them you'll find the words "not applicable" at least once when they was doing the review of this instant process.

And then there's three things that's very important that I find were not in place in any of these. Number one is the process was not equipped with an inhibitor kill device. For almost all reactions, there is some other chemical that you can introduce into the reaction that will stop or kill the reaction from taking place. That's a safeguard in case that the reaction gets into the exponential rate of growth.

The next thing is that the processes do not have adequate cooling or deluge systems that can stop the reaction from taking place.

And the number one thing that I find is the relief or the vent equipment is just not designed to handle the reactions or the pressures that can be generated from the reaction, and these are threads. These are things that are common to all of these incidents.

I've listed ten of them.

In the Lodi incident, I was a member of OCAW at the time. OCAW was one of the unions that petitioned for emergency temporary standard with OSHA. Several trade organizations opposed it, and OSHA has not acted.

But from that time in '95, we have had the Georgia Pacific in '97. We've had the Morton International in '98. We've had Phillips in 1999, where there was two dead and several injured. And then the most recent one was March the 27th of this year. We had one fatality, 74 people injured, eight of them with third degree burns over 50 percent of their body that are life threatening illnesses. These people will never be able to come back to work.

I believe now that we have the opposition we had when we asked for emergency temporary status was they said there's not been enough of them. I believe the body count is high enough, and we're having at least one a year, that it's time that more be done.

I would like to have seen the Board request that emergency temporary status, but I realize that the Board has not investigated the last two incidents that I have, the ones at Phillips. I wish they had have been able to come in, but in light that you don't have that information by not having investigated, then PACE stands ready to stand with the Board to work with this Board in a hazard investigation of reactive chemicals.

We would ask to be part of that. We think the Board is wise in taking that approach.

And on the recommendations that they asked for PACE to comply with the last recommendation to disseminate the material to our members, I stand here to tell you that PACE International will distribute to its 320,000 members the Morton incident and the recommendations and try to make a change in the work place as fast as we can.

Thank you for your time.

DR. TAYLOR: Thank you, Mr. Erwin, and it was also within the five minute time frame. I was counting.

MR. ERWIN: Thank you.

DR. TAYLOR: Very good.

Are there any questions of Board members of Mr. Erwin?

(No response.)

DR. TAYLOR: No. Thank you very much.

Diane Stein.

MS. STEIN: Good morning. Thank you.

It's not morning anymore, is it?

I'm Diane Stein. I'm with PACE, Local

2149, which represents the workers at Morton Chemical.

I want to thank the Board and the staff for the job that they've done in this investigation. I think it's clear that the need for the Board is crucial, that we need an independent agency in this country that goes in after these chemical catastrophes and does a root cause analysis.

It's beyond the scope of OSHA. It's beyond the scope of EPA, and we need an agency such as yourself in order to do these things and to come up with the recommendations that can be shared industry-wide.

I would like to urge you to rethink what the staff's recommendation has been on OSHA's role and what your recommendations to OSHA can be. I'm reiterating a little bit of what Glenn said, but I want to go a little bit beyond that.

Since the PSM standard was introduced in 1992, we've had a number of years now to look at the experience that companies have had complying with PSM, and I think there's a lot of evidence out there now about what the weaknesses of it are, and we need to rethink; we need to relook at it to try to strengthen it where the weaknesses are apparent.

In our shops, it is clear -- Glenn

mentioned this a little bit -- that when you go in and look at PHAs they're often not adequate. He talked about the fact that with our incidents and you look at the "what if" scenario. You can often find "N/A" as not applicable with something that clearly was.

It's a major problem with PHAs, and I think that we need to encourage OSHA to relook at that part of the standard to strengthen it and make enforcement of that part a bigger priority.

I'm glad that the recommendation is that you're going to make the recommendation for guidelines for OSHA. I don't think that it goes far enough. I think that whether you say that you don't want to base a recommendation on creating a standard on one incident alone isn't really the question.

According to your own statistics, there are 100 serious incidents per year. So I don't think that you need to necessarily wait for another study to come out. There's enough data out there now that shows that voluntary compliance to good practices isn't happening enough; that if we have 100 serious incidents a year, there's clearly a need for regulation, and I would ask you to consider strengthening the recommendations of the staff to include that in your final report.

I want to just reiterate something that

came up verbally, but in your written recommendations it lists as in the incident description that the causes of the incident were that the steam used to initiate the reaction was left on too long, and the use of cooling water to control the reaction was not initiated soon enough.

I think there's an understanding here that this was not operator error, but I want to reiterate that; that the lead operator on duty that night had 31 years of experience, and in our review of the case, we found that followed the standard operating procedure to the letter. So that that may have been the cause, but the cause was not operator error.

And, again, I believe that you understand that, but I wanted to make that very clear for everybody.

I'm trying to keep to the five minutes and cut out things you don't need to hear.

DR. TAYLOR: Okay. You've got one minute left.

MS. STEIN: Okay. We'd also like to ask you to consider a more formalized approach to the effect on communities. The communities are at risk from these incidents, and we urge you to include a systematic approach when you're assessing your impact at the impact on the community in all of your investigations.

And it's our belief that even where shelter in place has not occurred, there may be risks that aren't apparent at first glance in terms of exposure to intermediate chemicals that are produced in the course of a reaction.

We'd like you to take a more systematic approach to looking at that.

I want to reiterate Glenn's commitment that PACE will support the study, and we'd like very much to participate in it if that's the route you choose to go.

And I'd also like to acknowledge that Rohm and Haas, in conversations with them, has supported what we believed the recommendations would be, and that we're looking forward to working with them, and that we call on Rohm and Haas and all responsible chemical companies to join with us in calling on OSHA to promulgate regulations to prevent these incidents.

Thank you.

DR. TAYLOR: Thank you very much.

Dr. Phil Lewis.

DR. LEWIS: Good morning. My name is Phil Lewis, and I'm Vice President and Director of Environmental Health and Safety for Rohm and Haas.

And for 15 years I've worked at Rohm and Haas Company in the area of environmental health and safety and speak to you today as a representative of the company an of the Paterson facility.

As the Board is aware, Rohm and Haas Company acquired Morton International and the Paterson plant on June 21st of '99. Today the Paterson plant is part of the Rohm and Haas manufacturing enterprise, and we aggressively moving to introduce the Rohm and Haas Company operating procedures into the plant.

In a minute I will address the specific efforts underway at the plant to respond to the recommendations of the Chemical Safety Board staff to insure a safe facility not only for the employees, but for the community.

I could think of few more frightening experiences than the fire/explosion at a chemical plant. For the employees at the Paterson plant, I'm sure it was a traumatic event and that it will stay with them for the rest of their lives. It certainly will with us.

Employees were injured, and fortunately all have returned to work. We cannot, however, minimize the disruption to their lives that this incident has caused.

The community, as well, has been interrupted with the frank realization of the problem of a major fire in the neighborhood.

It is for these reasons we are here today, I, in particular, to work together to prevent accidents at chemical facilities and demonstrate the ability of all our facilities to serve as safe employers and neighbors.

Rohm and Haas Company uses safety as a core value of the company. The best action a facility can take after an incident such as the one we are discussing today is to commit itself to insuring that future operations are done as safe as possible, and this company has directed its energies to rebuilding the Paterson plant and its processes. It is my hope that this hearing is another step for the core restoration of both employee and community confidence in the Paterson plant, and in particular, in the Rohm and Haas Company.

The Chemical Safety Board is uniquely qualified to help in this effort. When the Board was proposed nearly ten years ago, Rohm and Haas Company was the first and perhaps the most visible supporter of the establishment of the Board.

The Board conducts independent, highly

technical investigations that can look across individual facility incidents in a positive way to improve manufacturing processes and to assure safety in our industry.

We support your role and welcome your investigation at the Paterson plant.

We have carefully reviewed the draft report and have already offered substantial technical comments. With our changes which we understand are likely to be adopted in the final report, we find the draft report to be professional and a thorough investigation of the events that have led up to the explosion.

The report is extremely helpful as a basis to insure the health and safety of employees at the Paterson plant are fully protected. We agree in principle with the recommendations that the staff has outlined today. In fact, most of the recommendations have already been implemented at the facility.

I would like to detail the specific actions taken by the plant since the explosion and Rohm and Haas Company's acquisition of the facility last June.

First and most importantly, as has been mentioned here, Yellow 96 is no longer manufactured anywhere in the company, and to our knowledge, it is not manufactured anywhere in the industry.

Additionally, there are no other processes used in our plants that have the unique thermal characteristics of the Yellow 96 production process.

Discontinuing that product was not the only action taken. The next six actions I will outline address the recommendations that the staff made to you.

Rohm and Haas Company has a longstanding commitment to process safety management. As an additional measure, Rohm and Haas has committed to treating all reactive chemistries at Paterson as though they are OSHA regulated process safety management processes.

Rohm and Haas has also conducted regular process hazard analysis. All PHAs at the Paterson plant are current and will be reevaluated every five years, whenever new information or hazards are uncovered.

Thermal stability standards or studies are being conducted for all reactive chemistries at the Paterson plant. Nearly all chemistries have been tested, and the result of those studies indicate that emergency release systems currently at the plant are adequate for the design processes.

This testing is being done as a

precautionary measure and is an example of our commitment to safety.

Analyses are being conducted to determine what additional interlocks or quench systems are necessary at the Paterson plant. Rohm and Haas has identified one interlock that is needed, and it will be installed within the near future.

No quench systems have been identified at this point.

The Paterson plant is in the process of revising its standard operating procedures. Operators are being trained with the most current information available. Any remaining SOPs for reactive chemistries and the accompanying training are scheduled for completion by the end of August.

A new Safety Director has been recruited for the Paterson plant. This person is in position now and has been trained in the state of the art Apollo investigation techniques. These skills that this person brings to the plant will further enhance our ability to remedy issues before they become problems.

Rohm and Haas Company is deeply committed to the tenets of responsible care. Our goal is to insure that none of our plants around the world pose a risk to employees or the community.

Throughout the company we have a comprehensive management system for assessing process hazards, sharing them across the organization and communicating widely throughout all of our worldwide facilities any new information, including key learnings from near misses, other safety incidents, and research studies.

That commitment starts with the Manufacturing Council, headed by Tom Archibald, Vice President and Director of Operations and Manufacturing for Rohm and Haas Company, and assures that all the information necessary to operate our facility safely is shared and understood throughout the company.

I understand I'm at the limit of my time. Let me say just to sum up that we believe that continually reducing the risks associated with chemical processes is important. We believe we all need to work together to do that.

I would caution the Board and everyone here to remember though that there is no such thing as absolute and zero safety. No matter what we do, there are residual risks.

There are, however, vast benefits to chemistries that we provide in those products. We look forward to working with you to insure that we can provide those benefits and continually reduce the risks.

Thank you.

DR. TAYLOR: Thank you, Dr. Lewis, for your comments.

I'd like to remind you if you are not allowed to complete your comments or you would just like to submit written comments to the Board, you may do so. We have as our deadline Friday, which is July 21st. So please submit those, or you can give those if you have them already typed and written -- you can leave those with Bill Cogan who just walked through the door or Maureen Wood, who is standing in the back. There she is on that side if you have anything you'd like to give us today.

Otherwise it can be submitted also by E-mail. Our Web address is www.chemsafety.gov.

Moving along with our public comment, Mr. Robert Oliver.

PARTICIPANT: (Inaudible.)

DR. TAYLOR: Thank you.

Steve Mart (phonetic).

PARTICIPANT: (Inaudible.)

DR. TAYLOR: Thank you.

Ted Carrington.

MR. CARRINGTON: Good afternoon. My name is Ted Carrington, Local 2149, PACE. I'm presenting this testimony on behalf of the New Jersey Work Environment Council, a statewide organization composed of unions, workers, community and environment groups or organizations, where I serve as a field organizer.

WEC supports the rights of workers and citizens to monitor chemical safety and take action to prevent hazardous conditions. The organization also supports stricter regulations of explosive chemicals and systematic approach to chemical safety by chemical companies.

The mix of industry, transportation, and residential communities in New Jersey has many negative public health implications. One particular troublesome outcome is that our citizens breathe unhealthy air one out of every three summer days.

This is not news to residents of cities like Paterson where foul air is common, nor was it a surprise last month when WEC released a report identifying the proximity of public schools in Paterson and Clifton to industrial facilities storing or emitting to the air high volumes of toxic chemicals.

Our research found that the top five industrial air polluters in Paterson are all within a mile of at least eight public schools. Rohm and Haas, formerly Morton, the subject of today's hearing, is within a mile of three public schools in Paterson and one in Elmwood Park.

Why should members of the community be concerned about the proximity of homes and schools to a company like Rohm and Haas?

First, because the facility in Paterson, like many other chemical makers across the state, stores and uses a variety of dangerous chemicals, including xylene.

Second, many of these chemicals have both long and short term health effects, and WEC is, therefore, concerned not only about the hazards posed, but also the chronic effects of chemical exposure.

Finally, in the event of chemical emergencies on the scale of the 1998 explosion being discussed today, WEC contends that most emergency medicine providers are unprepared to address the variety of health effects that can develop from exposure to the tens of thousands of chemicals now in industrial use.

WEC fully supports proposals made today for stricter federal laws regulating the use of reactive chemicals.

WEC also supports an approach to chemical safety that examines entire chemical manufacturing systems in an effort to determine root causes of incidents like the 1998 explosion at Morton.

Using this approach, teams of workers and managers conduct comprehensive investigations of each incident or near miss and work together to develop remedies.

However, given the lack of resources at federal and state agencies charged with environmental and occupational safety, and given the reluctance of many employers to address safety concerns of employees and neighbors, WEC also believes that workers and citizens alike should be deputized to monitor hazardous conditions and prevent accidents when necessary.

In Passaic County, Resolution 35 allows citizens and workers concerned about health threats from local facilities to call in experts and to petition the county health officer, who can then conduct an on-site survey of facilities.

It also stipulates that neighbors and workers can accompany the health officers inside facility premises unless employers refuse to allow their participation.

When it passed last year over the protests of New Jersey's chemical manufacturing industry, Resolution 35 became the first law of its kind in the country. Today this ground breaking law has the potential to provide citizens with the power to go beyond the right to know to the right to act.

It is WEC's belief that laws like Resolution 35 and even stronger measures that give citizens and workers the unconditional right to inspect dangerous facilities can help prevent the needless injury, illnesses, and even death that can result from serious chemical explosions like the incident in Morton in 1998.

Thank you.

DR. TAYLOR: Thank you for your comments.

Mr. Bill Kane.

MR. KANE: Good afternoon.

DR. TAYLOR: Good afternoon.

MR. KANE: My name is Bill Kane. I'm the President of the New Jersey State Industrial Union Council, which is a council of unions representing over 300,000 workers in the State of New Jersey from various industries, including PACE and UNITE.

In reading the materials that were provided, I mean, very thorough materials, let me just -- when I was driving over here this morning I was thinking about this Board, and I was thinking about the Transportation Safety Board and the Chemical Safety Board and the difficult job that you folks have of trying to figure out and investigate these incidents.

And I thought about the Transportation Safety Board maybe even having an easier job than you folks do because what they see is pretty clear, and it's not as vague.

But I thought sitting here reading this stuff; I said to myself, "I wonder what would happen. I wonder what the Transportation Safety Board would do if a pilot was bringing a plane into Newark Airport and instead of slowing the plane down to whatever the landing speed it he just decided he was going to land at 500 miles an hour and maybe not put the landing gear down and happened to survive."

I just wonder what the Transportation Safety Board recommendation would be about that guy if he happened to walk away from that plane. Obviously they would probably put him in a mental institution or they'd at least have him arrested or fired.

And then I looked at the incident at Morton and I said to myself, "Well, who would be the equivalent of being the pilot at Morton?" You know, and it has to be the plant manager, I would assume, and the flight crew would have to be the technical engineers and the professionals that are supposed to make sure that these things don't happen.

Somebody forgot to put the landing gear down. Somebody forgot to slow the plane down to proper landing speed, and those "somebodies" ought to have more than a recommendation made to them to implement the standards that they already had in place that they ignored.

And your report, quite frankly, points that out. In the summary, when you look at number five or number four, it says that he did not adequately follow recommendations made in 1989 to make tests to determine the rate of reaction and the rate of decomposition or to put safety devices on this equipment. That was ignored by management.

They changed the semi-batch to the batch system. Anybody that I know that ever worked in a chemical plant will tell you that's a synonym for speed-up. They get more done quicker that way.

Number five or number seven on your report talks about running a process at 153 degrees, and it clearly hindered the operator's ability to control the reaction. And operators reported to management temperature runaways. Management did nothing.

Changing the batch size gave a very clear warning that temperature excursions had increased. Changing the batch size is probably another synonym for speed-up. They were told that excursions were increasing. They ignored it.

Their internal PSN program did not address excessive heating, runaway reactions, and the inability to provide enough cooling. The operators' reports of batch deviations caused by temperature deviations were, again, ignored by management.

It's like the flight attendants trying to tell the pilot that the wheels aren't down and he's ignoring them.

The PSAM program did not require the use of industry good practices. Workers weren't warned of the dangers. They weren't trained properly, and they were ignored.

So I wonder what this Board's recommendation would be if the entire plant blew up, if the neighborhood was subjected to some catastrophic incident that annihilated scores of people. I would assume we would go after the people responsible.

The State of New Jersey is the most densely populated state in the United States. Almost anywhere you put a chemical plant, there's going to be population. If there's a major chemical incident at that chemical plant, there's going to be a catastrophe.

I would simply say in your recommendations, I understand the recommendation for the guidelines that OSHA and EPA should issue. I allowed the process that you have them go through, but, in fact, when Napp exploded, which is represented by another of our affiliates, in 1995, many unions petitioned OSHA for an emergency standard, and this is another clear indication that that standard was needed.

So I would recommend very, very highly, given the nature of this state, given the nature of the increased evidence that these reactive processes are being handled in less than a dangerous way; I would highly recommend that this Board recommend to OSHA that they issue an emergency standard.

Thank you very much.

DR. TAYLOR: Thank you, Mr. Kane, for your comments.

Sergeant Eric Zimmerman.

SGT ZIMMERMAN: Again, good afternoon. Greetings to everyone.

Okay. In light to everything that I observed here thus far, basically the incident that took place on April 8 in 1998 affected me personally because my family was less than a block and a half away from ground zero of the Morton incident, meaning my mother, my sister, and two nieces.

Okay. I had difficulty, as Mr. Gerald Poje -- is that correct? -- with the aspect of the kettle reactor. Okay. If this was something that was designed in 1962 and we're dealing with chemicals like Yellow 96, that's something that I would look at and suggest it be state of the art for the 21st Century.

What type of nomenclature and redesign was utilized on the kettle design if they expanded it from 1,000 to 2,000 gallons? What type of response was taken by Morton in making sure that if they was going to up-scale production of Yellow 96; what preventive measures were taken to alleviate a reaction of that multitude and under whose guidelines other than that which was utilized in London, England, within the United States were they allowed to do such a thing in close proximity with that?

It seems like, okay, for an example, and Mr. Kane, too. I appreciate what you spoke of using NTSB in conjunction with that because I would like to use the United Auto Workers and other facilities that mass product automobiles.

If you utilize a car that's from vintage

1962, you know you're going to have to find parts to replace it at some point for wear and tear in order for a smooth function and reaction from the vehicle.x

At the same level acts with a chemical reactor that was utilized at Morton. I mean, was there the glass lining on the kettle you examined for any type of faults? Were any other cooling devices that were utilized to make sure that the reactor temperature didn't go into a runaway situation, as was before mentioned?

What type of safety procedures did OSHA have in house, and were there any OSHA representatives in house at Morton Chemicals during the time of this incident that could have interceded along with, yes, the management and the supervisors who were so trained to respond to emergency reactions as such?

And you know, basically I'm baffled by it.

Another thing that troubles me is there was another incident as before mentioned -- a lot of them go unnoticed -- with the Hetarine (phonetic) Chemical Company, which is maybe two blocks difference from Morton, when they had a chemical reaction.

In that same community there was exposure to residential citizens. There was a young man that passed away that attended PS No. 20, and Passaic County

Board of Freeholders had a hearing inside PS No. 20 auditorium in the same week after the young man passed, and they also had a hearing at the County Administration Building, but there was no concrete evidence or no reasons really given in the investigations of due cause to that.

There were a lot of citizens that complained from the April 8th incident, and there were also complaints further from the incident which I don't know the exact date, but they had a marine chemical accident.

But the exposure that the citizens are facing this with this is astronomical, and I feel it's unsafe, and it's fear. I mean, most of the majority of citizens at Paterson aren't versed in chemical reactions or chemical guidelines per se in general, but I think this would be something that's in a simplified form that should be issued out to the community as a warning on how to prepare for such things or even other guidelines given as assistance to them in the form of whatever apparatus they might need to protect themselves in the even that there's a chemical reaction or release again in the future.

I versed myself a lot, and I know I'm going beyond my time, with Mr. Carrington a lot on issues because I live right now in the backdrop. I live less than 200 yards from Brown Chemical Company in Paterson, New Jersey. In Brown Chemical, we had a few incidents there within the last ten years, the last decade, that went unsung.

We had emergency response from Paterson PD and the Fire Department and Sheriff's Department Hazardous Response Team. But still the citizens suffer from this.

And again, like Mr. Carrington mentioned, it's in close proximity for public school. We have PS No. 21 and PS No. 10 right in the vicinities of those areas.

I guess my question is: what can be done for the citizens of Paterson either through the U.S. Chemical Safety Board or through OSHA and the EPA to prepare us so that we know how to troubleshoot and protect ourselves and our families in the event that another occurrence like this, God forbid, takes place.

DR. TAYLOR: Thank you very much for your comments, Sergeant Zimmerman.

I know with this report we did not address the issue of the surrounding community environmental to the extent of making recommendations on improvements that can be made. We're in the process now, as was mentioned by one of our staff members, in working with the Agency for Toxic Substances and Disease Registry to develop a plan for addressing community issues such as the ones that you've raised, and hopefully, God forbid, if there's a future incident somewhere, we will be up to speed on some of the environmental impacts and address the part of what could be addressed as far as community involvement.

SGT. ZIMMERMAN: Okay. In closing, one last comment. I would like to suggest similar to before my time what was done during the time they had the missile crisis going on, the missile threats from the former Soviet Union and the United States. There were drills that were given to the citizens of the United States, emergency warnings where they had fallout shelters, and so on and so forth, to take place.

Have we come to that level yet where we need that for basic population, the citizens in the surrounding areas, the most densely populated state, New Jersey?

My answer is yes, and I think something on that level should be looked at and observed.

DR. TAYLOR: Okay. Thank you for your comments.

Jim Nash from Occupational Hazards.

MR. NASH: Jim Nash, Occupational Hazards Magazine.

I just have a question, and that is whether the Board's deliberations on this matter will be made in public and whether the transcripts from that will be placed on the Internet.

I thought there was a commitment to that in December, but I could be mistaken.

DR. TAYLOR: If they're not made available on the Internet, you can also request a copy based on the FOIA request, Freedom of Information Act. We will have transcripts available from our offices.

MR. NASH: (Inaudible.)

DR. TAYLOR: The deliberations on our voting? No. We will review the report and vote separately as individual Board members, but there will not be another deliberation. This is the actual review of the public findings.

Thank you.

DR. POJE: Just to clarify, the Board members will receive the next iteration of a draft of the report. There will be a full written report submitted by the staff to us. Each of the Board members will receive that. We'll be charged with reviewing it. We'll have a certain date to have completed our review.

We'll either sign it as accepted as is, with minor modifications, rejected it with major modifications requested, and that will be the deliberative process that we'll use.

We won't sit in a session like this and say, "Who votes yes or who votes no?" because of the media matter associated with a scores of page report. So just to have everybody understand, there's not a meeting somewhere in Washington where we'll deliberate.

There will be a transmission to each of us Board members. We'll review that. We'll sign an acceptance or rejection with justification for why, and if it's accepted by us all, then it will become our official Board report, as the others that you've seen outside.

DR. TAYLOR: And once it becomes an official Board report, it then will be on the Web site for downloading as the other reports have been made available. Okay?

Okay. Ray Stever.

MR. STEVER: For the record, it's Stever.

My name is Ray Stever.

DR. TAYLOR: Stever.

MR. STEVER: I'm Vice President of PACE Local 2149, staff to the IUC, and I'm also the Executive Vice President of the Passaic County Labor Council.

I worked very hard with Ted Carrington in developing the neighborhood hazardous prevention law, which is the only law in the country, and it's right here in Passaic County. This law was developed to help communities and companies and workers work hand in hand in developing safety.

Napp, Morton, Phillips, they were all tragedies, and we need to be very conscientious of training our employees and making sure safety is a priority in our communities.

It was weird before when I was listening to the members over there speak about how in England in developing these programs you have the law, you have the legislation, you have business, and organized labor, and that seems to be missing in this country.

Nobody wants to listen to the unions, and yet unions develop the health and safety programs that not all, but many companies adopt to protect the workers.

We have an abundance of knowledge. Yet there are many companies out there that refuse to listen. There are many companies out there that find cost to be more important to them than the safety of their workers.

Now, companies are vital to the existence of communities. Communities are vital because they supply the workers to the companies. But communities cannot have catastrophes happen.

I was at School 20 when we spoke to the Freeholders about the development of this law, and I spoke to the security guard there, the woman who has been affected by the Heridan explosion or the catastrophe that they had that affected the school.

Paterson is very dense in itself, not even so much the State of New Jersey. There are chemical plants around the corner scattered around. Now, this isn't just the point of chemical plants, but it's a point of companies taking a responsibility and training and educating, listening to the people, to the community, to the unions just to know what the process is.

Because where I come from, the company I work for, even though it's pharmaceutical, I'm the head of the Health and Safety Committee there. I speak with the company. They listen, but yet they go by a lot of the laws. OSHA regulations limit us to this. So we only go up to this threshold.

What I heard today went beyond any threshold, went beyond limitations placed by OSHA. And why are some of these limitations placed? Because our own government places the limitations upon OSHA. They won't let them expand. They won't let them give them more power.

It isn't to restrict business. Business is good, and we need to work hand in hand, but business needs to listen and our government needs to listen because without business there's no communities, and without communities there's no business.

Thank you.

DR. TAYLOR: Thank you for your comments.

Eric Frumin.

MR. FRUMIN: Good morning or good afternoon.

DR. TAYLOR: Good afternoon.

MR. FRUMIN: My name is Eric Frumin. I'm the Director of Occupational Safety and Health for the labor union UNITE.

We represent thousands of people who either live or work here in Paterson, in Passaic County, and we also represented the workers at the Napp Technologies Company plant in Lodi, New Jersey. Two of those workers are here today, Jim Gannon, who was an operator and a survivor of that explosion, and Al Giles, who was a lead maintenance mechanic -- master mechanic.

I would like to thank Senators Lautenberg and Toricelli for the interest and support they've shown for the Board and for chemical safety. I certainly thank the Board and the staff for the hard work you've done on the Morton investigation and on the reactives issue in particular.

And of course, to thank our brothers and sisters at PACE Local 2149 and the International Union for their work on chemical safety.

The explosion at Morton revealed once again a gaping loophole in OSHA's process safety management standard. OSHA has known about this loophole since it finished its investigation of the Napp tragedy and issued its citation in October '95.

The explosion at Napp involved thousands of pounds of powdered aluminum. Under the right conditions, powdered aluminum reacts like gunpowder. At that point the mixing vessel at Napp was no longer a so-called blending machine. It was more like a rocket or a bomb.

The day after the explosion at Napp, the surviving workers and managers assembled at our union hall here in Paterson. One of the management personnel asked the company's president where was the chemist?

Well, there were two answers to that question. Dr. Fred Schaefer, Napp's Vice President for Regulatory Affairs, who had a record of falsifying his professional credentials and violating environmental laws, had been at home at the time of the explosion, but to the best of our knowledge, he was in command of the situation by phone, and in our view was responsible for the order to reverse the earlier evacuation, to withhold notification to the Lodi Fire Department two blocks away.

That decision or that combination of decisions sent five men to their deaths and resulted in extreme injuries to other workers, emergency service personnel and the Saddle River. It also terrorized the community.

Where was the chemist?

The other answer to the man's question was really another question. How could anyone be so incredibly incompetent as to allow a mixture of 5,000 pounds or more than that of explosive powdered aluminum to smoke and sputter and still not declare an imminent emergency?

At the Napp company the management was demonstrably incompetent. The incident at Napp thus provides a stunning example of the need for strict OSHA regulations on even the most obvious chemical hazards.

OSHA and EPA prepared their 1997 report on the Napp incident and requested a review of it by, among others, Mr. Gerald Scanol, the President of the National Safety Council, former Director of OSHA, and former corporate Director of Health and Safety for Johnson & Johnson.

In '99, he reviewed the OSHA-EPA report and said it was inadequate because it failed to adequately investigate, quote, management standards and best practices to improve safety in the industry, such as," and I'm continuing to quote, "the qualifications, credentials, and competence of the managers involved in the decision making from new product review to emergency response. This review was especially important in light of the apparent bad decisions by management as the crisis developed."

Scanol then concluded, "One of the major recommendations of the OSHA-EPA report is essentially that companies should comply with the existing regulations. Do companies not know about the rules? Aren't they worried about the consequences of noncompliance or don't they think they'll ever get caught?" This is all Scanol's words.

Essentially he said the question is: why did this company ignore the law, and what should be done to reduce the likelihood of companies ignoring the law in the future?

It is completely unacceptable that such reactive material are exempted from OSHA's process safety management standard. When OSHA finished its investigation in 1995, OSHA clearly stated its intention to change the PSM standard to cover reactive chemicals more effectively.

Unfortunately, even though OSHA has repeatedly announced its intention to close this loophole, OSHA has been unable to do so. We mean no disrespect to OSHA. We understand they're busy. We, in fact, are asking them to change many other standards, and indeed, there could be a root cause investigation of why they've delayed.

But it simply inexcusable that this delay continues to this date. We call upon the Chemical Safety Board to strongly urge OSHA to move as quickly as possible to take action on the severe hazard posed by reactive chemicals.

The exclusion of highly reactive chemicals from OSHA's or even moderately reactive chemicals from OSHA's PSM standard still endangers workers and communities. It is high time that OSHA put chemical industry managers clearly on notice.

There are a number of managers from the chemical industry today. I hope others will pay attention to what we say here.

To you managers, no matter what you tell us about your ability to properly manage chemicals, workers in the community are entitled to the strictest regulations possible, including detailed requirements for management competence and performance.

So not only where was the chemist, but who was the chemist and what did he or she know?

And we also say to you: no matter what you think, no matter how safe you think your process is, you have to prepare for the worst and give workers a chance to protect themselves.

We appreciate the Board's investigation, the staff's work, the recommendations for a proposed study. We understand there is a need for the best available information in setting new standards, especially in light of the rank ignorance and incompetence which the chemical industry managers have displayed both at the Napp incident and at Morton.

But until OSHA changes those standards and chemical industry managers comply with decent standards, workers and communities will live in fear, and as a nation we must do much better.

Thank you.

DR. TAYLOR: Thank you, Mr. Frumin for your comments.

I'd like to --

MR. FRUMIN: I have a written version of that I'll supply for the record.

DR. TAYLOR: Great, and you will provide that. Thank you.

The next name is Michael --

MR. McAULAY: No comment. Michael McAulay.

DR. TAYLOR: Okay. Thank you. McAulay.

Jim Gannon with UNITE.

MR. GANNON: Hi. I'm Jim Gannon. I work in Napp Chemical.

I was about 90 feet from the TK when it exploded.

I'd like to thank the Board for letting me speak here today.

One of the bright or positive things that came out of the Napp explosion was this Chemical Safety Board.

The only thing I see that's the same between Morton and Napp was Morton started at eight o'clock in the evening. Although the Napp explosion happened at 7:43 on the 21st of April, it was started the night before.

I believe these things can be prevented by requiring a qualified chemical engineer to be on site while the process is being done or to take it to a point where there is no more danger.

We had two people at Napp in management who were forced into retirement in a downsizing in 1993. They had a procedure of any batches that were critical or involved hazardous chemicals, they were started and finished on the day shift, and when possible, they were started on the day shift. People were kept overtime, and they were taken to a point where they could be put on hold, and then the following day the process was picked up again and finished by the day shift.

They're always whipping up new things in the lab, new batches. A chemical operator is a chemical operator. He's educated by on-the-job training. When a new batch comes along, he's not a chemical engineer, and he can't notice things or pick up things that a chemical engineer would pick up, things that aren't normal.

I don't know. Words like "financially unfeasible" shouldn't come into play when you're talking about safety and human life.

It should be done on a day shift or chemical engineers should be, you know, kicked out of bed and made to come on the second and third shift when necessary when dealing with hazardous chemicals.

And it's just my opinion, and I've said it to a couple of politicians before, that I don't think you're going to see a change in attitude with the chemical industry. You're talking about a multi-billion dollar industry. So if you fine them a couple of million dollars, they don't care.

Until there's laws passed where if people have, because of incidents like this, suffered debilitating injuries or death, when you start talking about criminal penalties and jail time, I think then you'll see a difference in attitude.

Thanks a lot.

DR. TAYLOR: Thank you very much for your comments.

It says FF Andrew Morabito.

MR. MORABITO: Fire Department, ma'am.

DR. TAYLOR: Oh, the Fire Department. Thank you. Fire Fighter.

MR. MORABITO: My name is Andy Morabito. I'm an investigator with the Paterson Fire Department.

I've been on the department for about 13 years, investigating for about the last six. This was what we call in the department "my fire" that night when it came in, and I did the initial investigation of the incident.

That included going to the hospital to interview the people who were operating the kettle at the time the explosion occurred.

I've just got a couple of questions. Maybe I should have asked earlier when the Board was asking. I sort of had the impression it was just you guys who can ask the questions, but I'd actually like to ask a couple of questions of the investigators.

Before I do, I want to point out one thing. I know it was stated that it was about a 30 minute response for the fire department. I realize you guys didn't term the response was 30 minutes. It's just the words you used.

The Passaic Fire Department was on the scene within three to four minutes after the first call was made, and standard procedure with a HAZMAT incident such as this would have been to wait until we determined what was burning in there before we start putting water on it, before we create a much worse situation than we already had.

The fact that water didn't go on that fire for approximately 20 minutes or so really didn't have much to do with the actual damage that was caused. Most of that was caused by the initial explosion, and in fact, there was relatively little fire damage to the structure itself, given the kind of incident we had.

I had a personal friend of mine tell me he saw the explosion from across the river and described quite, quite an explosion, literally a fire ball hundreds of feet above the top of the building.

So anyway, I just want to make it clear that PFD, Paterson Fire Department, was on the scene very quickly, and we followed all kinds of standard procedures in terms of putting any water on this fire before we determined what actually was burning.

A few things I want to ask, and I'm not here to assign blame. We have no -- what's the word I'm looking for? -- we have no agenda here. I don't care. We're just called to a scene to discover the cause and origin of a fire, and that was my job that night.

When I went to the hospital that night, I interviewed a few people who were operating the kettle that night and who gave me good first hand information as to what they saw occur.

The following day a meeting was held with the management from Morton Chemical at which time I expressed some of the things I had heard that night from the operators, and I was given the distinct impression by one of the managers -- I'm not going to get into names unless you want me to do that. That's all in my report -- that procedures were not being followed by the operators of the machines, not the recommended procedures.

Now, my question to the Board is sort of a couple of questions. This recipe sheet, which I was given the day after the fire and which was Morton's way you mix this batch up, this recipe sheet was given to me, and I noticed that the date created was August 23rd, 1990. It was revised five years later.

And one of the questions I want to ask is: did you ever get a hold of the original sheet, and why was it revised? I.e., why fix something that isn't broken kind of?

I'm just wondering did you ever get a hold of the original batch sheet.

PARTICIPANT: (Inaudible.)

MR. MORABITO: Okay. And again this is

just sort of PFD now. Is it your contention that had this procedure been followed by the letter, that this would not have occurred? This incident would not have occurred, or are there things in this batch sheet that are incorrect and, if followed by the letter, chances are this incident would have occurred anyway?

DR. TAYLOR: Mr. Morabito, thank you for your comments.

If you have some additional information, we may not be able to answer all of the questions that you have now, but if you could pass that information to our investigators.

MR. MORABITO: Sure.

DR. TAYLOR: Remember that our final report has not been issued yet. So we'll take the information that you have.

MR. MORABITO: Okay. So there is no answer really to this question as to whether or not you believe that if the procedure had been followed as written out by the Morton managers that this would not have occurred.

DR. TAYLOR: I don't think we can answer that right now, no.

MR. MORABITO: You can't answer that now. Okay. All right.

Thank you very much.

DR. TAYLOR: Thank you.

Syl Turicchi.

MR. TURICCHI: My name is Syl Turicchi.

DR. TAYLOR: Turicchi.

MR. TURICCHI: And in light of the late hour here, I'll be as brief as I can. I'm with the Center for Chemical Process Safety, and I'm the senior manager of that group.

First of all, I'd like to applaud the Chemical Safety Board's efforts here in sorting through some of these incidents and the work that you're doing to make recommendations to improve safety performance and the situation here, help reduce incidents, and so forth. I think it's a tough task, and you guys are doing a good job working on it.

CCPS is a nonprofit organization, and our mission really is similar to or like or in cooperation really with your mission. We're committed to develop engineering and management practices and work processes to help mitigate these types of incidents.

I just wanted to report that we do publish books. We hold conferences. We develop training courses, and we do have a conference coming up in October where, in fact, this incident is going to be presented and reviewed and discussed.

So part of the recommendation to disseminate this information, we're going to act on that pretty quickly.

We've also just published a book last year on batch reaction, process safety and batch reaction processes, and a lot of good information is in that book, and in fact, we're also about to release a new process safety management system assessment took called Pro Smart that I think, you know, when used to take a look at management processes for process safety management could help people understand where weaknesses are and fill in the blanks around making improvements.

So I just wanted to update the Board on those activities that we're working on, and in fact, we are also doing some work around the hazardous and reactive chemicals, and probably would like to be involved in that work as it goes forward, too.

Thank you very much.

DR. TAYLOR: Thank you, Mr. Turicchi, for your comments and we appreciate your assistance.

Any other comments, public comments?

(No response.)

DR. TAYLOR: Any final comments from the

Board?

(No response.)

DR. TAYLOR: Then hearing none, thank you, again, for attending this meeting, and this meeting is now adjourned.

(Whereupon, at 1:20 p.m., the meeting in the above-entitled matter was concluded.)