CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD

BOARD OF INQUIRY

SIERRA CHEMICAL COMPANY

KEAN CANYON EXPLOSION

Thursday, April 16, 1998

C. Clifton Young Federal Building

Room 5041

300 Booth Street

Reno, Nevada

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I N D E X

RENO, NEVADA, THURSDAY, APRIL 16, 1998, 9:05 A.M.

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CHAIRMAN HILL: Good morning. I would like to call this meeting to order, and it's my pleasure to welcome you to the Chemical Safety and Hazard Investigation Board's first Board of Inquiry. My name is Paul Hill. I'm Chairman and Chief Executive Officer of the Chemical Safety Board, and I'll be chairman of the proceedings held here today.

Assisting me today is Christopher Warner, who is general counsel to the Board, and also present is my fellow Board member, Dr. Jerry Poje.

Jerry, would you please stand? Thank you.

Before we begin, I'd like to say a word to the family members of the victims who are with us here today and those of course in the community. All of us feel an enormous sympathy for your grief these past three months. We cannot claim to know what you have gone through since the morning of January 7th. We can, however, make sure that we dedicate all possible resources to finding out what happened that morning and recommending what we can do to make sure that it does not happen again. This Board of Inquiry is a major step toward these goals.

Public sessions such as these are exercises in accountability: accountability on the part of the Safety Board that it is conducting a thorough and fair investigation, accountability on the part of regulatory agencies that they are adequately regulating the industry, accountability on the part of the company that it is operating safely, accountability on the part of equipment manufacturers and other suppliers to the company as to the design and performance of their products, and accountability on the part of the work force that they are performing up to the standards of professionalism expected of them.

This Board of Inquiry is part of the Safety

Board's investigation of the explosion that occurred nearby on January 7th, 1998. On that day at 7:54 a.m., two explosions occurred in rapid succession that destroyed Sierra Chemical Company's Kean Canyon Plant near Mustang, just east of here. The explosions killed four workers and injured three others.

The Safety Board sent in a team, under my personal direction, to investigate the explosions in an attempt to understand the causes of the incident. The investigation focused on the sequence and potential sources of detonation at the facility in order to identify the most likely initiating event and the equipment, management systems, manufacturing processes, and human performance failures that led to this explosion.

We are here today in furtherance of the CSB's search, not only for the cause of this accident, but even more importantly for ways to make sure that such a tragedy never happens again. We cannot change the events of January 7th, but we can understand the factors which contributed to this accident and make certain that those factors are brought to the attention of all the individuals capable of eliminating them from similar operations. So far, the Safety Board has dedicated all of its available resources, energy and time since January

7 on this investigation. Other organizations have also spent time and money on their own investigations, and in some cases, continue to do so.

All of the CSB's work has been done in an effort to reach the goals, the two goals of this investigation: learning the ignition source that sparked the explosion, and I believe the more important, finding the best means of reducing the likelihood of such explosions occurring in the future.

This Board of Inquiry is being held for the purpose of supplementing the facts, conditions and circumstances discovered during the on-scene investigation. We will also examine any pre-incident knowledge of the risks posed by the manufacturing operation to assess what actions might have been taken and by whom to have either prevented this accident or to have lessened the potential that it would occur. This process will assist the Board in determining the probable cause and in making recommendations to prevent similar accidents.

These proceedings may tend to become highly technical affairs, but they are essential in seeking to reassure the public that everything that can be done is being done to insure safety of those who are in industries involved with chemicals. The purpose of this

Board of Inquiry is not to assign fault or blame, nor do we come to settle any disputes resulting from this incident. It is not being held to determine the rights or liability of private parties, and any matters dealing with such rights and liability will be excluded from these proceedings.

I want to emphasize once again the purpose of this inquiry is to supplement the facts discovered during the on-scene and subsequent follow-up investigation of the accident through witness interviews. We want to ensure the accuracy and completeness of the factual record to assist our staff in completing its examination of the incident and related issues, and to better inform the explosives industry of actions they should take to avoid another such incident.

Today you will hear presentations on our efforts to do so. First, to determine the sequence of the explosions, and second, to determine the cause of the initial explosion. And you will hear about the work designed to determine the credible ignition sources that could have been involved. In particular, you will hear reports from the Board's investigators on safety issues arising from the accident and tentative recommendations to address the cause of this incident.

One day before the explosion, on January

6th, 1998, the United States Environmental Protection Agency entered into the Federal Register changes that removed high explosives from the list of regulated substances under the Risk Management Plan Rule. The document entered into the Federal Register reads, and I quote:

"EPA concluded that current regulations and current and contemplated industry practices promote safety and accident prevention in storage, handling, transportation, and use of explosives. The Agency believes these actions effectively close the remaining gap in emergency planning and response communications. Therefore, EPA is taking Final action to delist explosives from the list of regulated substances under section 112(r)" of the Clean Air Act.

This action was taken notwithstanding the latest figures available from the Federal Bureau of Alcohol, Tobacco and Firearms on explosives-related accidents in manufacturing type industries. ATF reports that from 1994 through 1996, there were 46 such accidents which resulted in 119 -- 46 deaths and 119 injuries.

It is my intent to have this Board continue to monitor events similar to the one we are examining today for the purpose of determining why deadly accidents occur and whether to make recommendations to EPA to correct what may be a potential threat to public health and safety. The Board also will conduct a thorough review of what the EPA referred to as voluntary industry practices which were compelling in EPA's decision to delist the explosives.

We plan to conclude today's activities by 5:00 p.m. The Board of Inquiry is an administrative, fact-finding proceeding with no adverse interest or adverse parties. To reiterate, it is not our purpose to determine the rights or liabilities of any persons, agencies, companies, associations or parties, and the Chemical Safety Board will not make any attempt to do so. Matters directly related to such rights and liabilities will be strictly excluded from these proceedings.

Copies of the list of CSB investigators who are presenting information today, and I'll introduce them very shortly, as well as organizations which have accepted our invitation to participate in the Board of Inquiry have been made available. Mr. Phil Cogan, who is with us today, representing the Chemical Safety Board, he's here just to my right, is the official responsible for external relations and can furnish copies of the list to provide access to the exhibits.

The Safety Board is a public agency engaged in the public's business and supported by public funds. The work it does in the business of chemical safety is open for public review; our investigation is an open book.

Information on the Safety Board, its staff and activities, including this investigation, and the Board of Inquiry is available free of charge to the public through our home page on the Internet. Our home page can be found by looking up www.chemsafety.gov. And there will be information again regarding this particular proceeding.

A public docket has been established on the investigation and will contain all exhibits, transcripts and related materials. We expect the complete the docket will be available for inspection at the Safety Board's Washington, D.C. headquarters later this spring.

The Safety Board has invited certain governmental agencies, companies, associations and organizations to participate and assist the CSB in this Board of Inquiry. These organizations have been selected because their participation in the proceedings is deemed necessary to public interest and because their special knowledge will contribute to the development of pertinent evidence concerning the issues to be addressed.

The Safety Board's investigator in charge will first provide evidence concerning the issues to be addressed. Then he will -- he and the members of the team will begin the presentation of the facts, analyses, causes and conclusions of the investigation that they have determined. Following each presentation, the invited organizations will be asked if there are additional facts to be known to the CSB and additional areas of inquiry that should be considered by the investigators upon conclusion of the proceedings.

No one other than the designated speakers will be recognized. I will receive all evidence that may be of aid in determining the cause or causes of this accident. Questions, comments or exhibits not pertinent to this investigation, or merely cumulative, will be excluded.

After the spokespersons have been given the opportunity to speak, the Board of Inquiry will then proceed to question the investigator as necessary. This process will be repeated for each successive presentation made by the investigative team present here today.

Questions may be directed by me or by counsel to the Board as well for legal clarification of issues.

As Chairman of this Board of Inquiry, I will be exclusively responsible for the conduct of these proceedings. I will make all the rulings regarding the conduct and the content of these proceedings and on the admissibility of evidence, and all such rulings will be final. All questions concerning the proceedings should be directed to me. Cross-examination of the investigators, in the legal sense of that term, will not be permitted, nor will materiality, relevance, and competency of the investigator's testimony, exhibits or physical evidence be subject to objections from the floor.

However, even after today's session has ended, any interested party will have the opportunity to submit proposed findings of fact, conclusions and recommendations to the Board. I strongly encourage use of this opportunity for any of you out there who may be interested in providing such information.

If you decide to submit proposed findings, conclusions or recommendations, please send them to the CSB at 1201 Pennsylvania Avenue, NW, Suite 300, Washington, D.C., 20004, and do so within 30 calendar days of this proceeding, which will be May 15th. They also may be sent by fax, and that number is available from the staff for anyone who is interested.

Also we have an email address. Also at chemsafety.gov that information can be provided to the Board within this 30-day window that we are seeking additional comments from any of you who are willing to do so.

All proposals that you may submit will be made part of the public docket of this investigation and will receive careful consideration during the CSB's preparation of the final report of this incident.

At this time I will take my jacket off and ask that we call on John Piatt. I'd like to introduce John, who is the CSB's lead investigator. John is the investigator in charge. He is a professional engineer in safety engineering. And he is a certified safety professional, a certified industrial hygienist and a graduate of the Army Material Command's safety engineering program.

I'd also like to recognize seated next to him is Mr. Dennis Walters, at the end of the table actually, who is a safety management systems expert and accident investigator.

Seated between them is Dr. Mike Failey, who is a research chemist for explosive ordinance systems.

In addition to these individuals, the CSB investigative team included other members, although they are not present to make presentations with us today. They are: Miss Cheri Foust, who was a member of the team and was present during the investigation. She is an industrial hygienist and a certified hazardous materials manager.

Mr. Ken Harrington, who is a process safety engineer and a management and analysis specialist; and Miss Susan Rose, who is a chemical engineer and a safety analyst, all of whom participated with the three individuals with us today in the investigation.

I would like to pause for just a moment and ask if there are any questions regarding the procedure that I have just outlined today. Is it well understood exactly how we will proceed? And then I'll go forward with the other introductions.

Okay. Thank you.

Also present, let me introduce the CSB's other employees who are available. They are Dr. Phyllis Thompson, who is in the back of the room, Mr. Phil Cogan, who I mentioned earlier who can provide you with any information you need or addresses or phone numbers for supplying information, and Miss Shirley Lambert, who is also seated with Phyllis. You'll recognize them by name tags that they have.

And please contact these individuals or any of us if you have other administrative concerns that we may be able to address today.

Many local, state and other federal government agencies, Sierra Chemical Company, Battelle Memorial Institute, and the U.S. Department of Energy's Pacific Northwest Laboratory, Oak Ridge National Laboratory, all worked with the Safety Board in this investigation to determine the cause of this explosion and measures that can prevent its recurrence. I wish to publicly express our appreciation for these, of all these organizations.

Neither I nor the Safety Board personnel will attempt during these proceedings to analyze the testimony we receive today, nor will any attempt be made at this time to determine a final probable cause of this accident.

The full Safety Board, including Dr. Poje, who is with us today, will make these types of analyses and cause determinations after consideration of all the evidence gathered during this investigation. The report on the incident involving the Kean Canyon explosion reflecting the Safety Board's analyses and probable cause determinations will be considered for adoption and therefore full public disclosure at a Board meeting later this spring.

I am pleased that the media is covering this Board of Inquiry today. This is a public proceeding, and many of the people of the State of Nevada will rely on the media to learn what transpires here. I will ask you, however, not to conduct any interviews here in the conference room. All interviews should be conducted outside this room for those of you who wish to do so.

Also, there are meeting rooms adjacent to this conference room for the Safety Board staff and family members of those who perished or who were injured in the explosions, and the news media representatives are not authorized access to those meeting rooms.

I would now call on the organizations seated at the other tables which I have not introduced at this point and invite them to participate in the inquiry. I will ask that each table's representative stand, and for the record, identify themselves and state your affiliation and the organization you represent and also introduce the other organizations at your particular table.

First of all, I'd like to call on the local emergency response organizations and ask that you introduce the other members at your table. Who will do so?

MR. GARRETSON: My name is Richard L.

Garretson, Detective for the Washoe County Sheriff's Office assigned to major crimes.

Seated to my left is Fire Marshal Roy Slate from the Truckee Meadows Fire District.

Seated to my immediate right, Robert Sack from the District Health.

To my far right is Dave Atkinson. He's also employed by Washoe County Sheriff's office as the Supervisor of Criminology.

CHAIRMAN HILL: Thank you, Richard. We appreciate the local response organizations being here, and again, your participation in the proceedings. I would now like to call on the state enforcement agencies.

MR. SWIRCZEK: Mr. Chairman, my name is Ron Swirczek, Administrator of the Nevada Division of Industrial Relations. One of our responsibilities is work place safety or the regulation of work place safety in the State of Nevada.

Seated with me at the table today is Danny Evans, the chief administrative officer of the Nevada OSHA program; Mr. Calvin Murphy, the northern district manager of the Northern Occupational Safety and Health program; and the senior investigator on the Sierra Chemical agency, Mr. Rich Meier, senior industrial hygienist.

CHAIRMAN HILL: Thank you. Again we appreciate your participation here today.

Next I'd like to call on the front table, particularly the Clark Commission, and ask you to represent the representatives at your table.

GENERAL CLARK: Mr. Chairman, I'm Tony Clark, the Adjutant General of Nevada, and I have been appointed by Governor Miller as chairman of the Governor's Commission for Work Place Safety and Community Protection.

To my immediate right is Allen Biaggi, who is a member of the Commission and who is the Deputy

Administrator of the Nevada Divison of Environmental Protection; and to his right is Lew Dodgion, also a Commissioner and the Administrator of the Nevada Divison of Environmental Protection.

To my left is Tim Crowley. He is one of the Governor's executive assistants, and he is also the Executive Assistant to the Clark Commission.

CHAIRMAN HILL: Thank you. Again, welcome, and we appreciate your participation.

At this point all of the exhibits that will be presented today have been entered into the docket. Mr. Piatt and the other members at the table will go through information and will refer to various charts, graphs, and photographs taken from the site. At points throughout the presentation of the three investigators on our team, I will pause and ask the other tables of organizations, responders, enforcement agencies and the Clark Commission if you have any further points or issues to offer regarding that portion of the presentation. So we will proceed following that general format throughout the next major portion of the presentation itself.

And then later this morning, after the information has been presented, I will also come back to each of the tables and ask if you have additional closing remarks that you would like to make regarding this incident and provide those also for our investigators.

Before asking for presentation, I will call on the tables, the presentation of our investigators, I will call on the tables first to see if indeed you want to provide any of the initial assessment and groundwork that you participated in that you would like to put on the record before we get to the investigators. So if there is any brief statement that any of the tables would like to make, anything from the Clark Commission at this point?

GENERAL CLARK: Not at this point, Mr. Chairman.

CHAIRMAN HILL: Thank you. We will again

allow you, as I said earlier, in conclusion of the
presentation to also provide follow-up.
From the state regulatory agencies,
Mr. Swirczek?
MR. SWIRCZEK: Mr. Chairman, Nevada OSHA is
currently in the final stages of its investigation.
Therefore, we will refrain from comment at this time.
However, we'd like to make it clear that we will submit
all findings and recommendations to the U.S. Chemical
Safety Board. We anticipate that will occur sometime
next week.
CHAIRMAN HILL: So it is just a matter of

timing that your work with completing your investigation has not wound itself up at this point that you can make that statement today?

MR. SWIRCZEK: Yes.

CHAIRMAN HILL: Thank you. We certainly understand that.

Now I'd like to call on the emergency response organizations, if there is any statement you would like to make, presentation for consideration, before we get to the information submitted by the investigators.

MR. GARRETSON: None at this time.

CHAIRMAN HILL: Okay. Again, thank you, and all of you will have the opportunity to provide additional remarks as we proceed through the investigative scenarios, information that is presented by our investigators.

Mr. Piatt, you lead this investigation, a team of people over a lengthy period of on-site work as well as follow-up work. You have prepared at least an initial assessment.

I'd like you to walk us through that information this morning such that everyone understands where the investigation has led us to this point and where we might be able to also use this in today's forum to conclude the Board's work in this area. So I'll turn the floor over to Mr. Piatt.

MR. PIATT: Thank you, Mr. Chairman. At this time I'd like to first give a brief introduction of the people at the table and introduce myself, and in turn, let each of the other investigators introduce themselves and give a little bit of background of their experience and how it relates to our investigation.

I have degrees in mechanical and industrial engineering and Master's Degree in industrial engineering, specializing in systems safety. I have worked with a variety of government agencies, both local and national as well as with private industry.

In working with those agencies, I have worked or conducted accident investigations in at least four agencies now.

At this point I'd like to introduce Mike Failey and let him give a little additional background for himself.

MR. FAILEY: Mr. Chairman, my name is Mike Failey, and my background includes a Bachelor of Science degree in chemistry from the University of Wisconsin, Ph.D. degree in nuclear and environmental chemistry from the University of Maryland. I have been involved with research activities with military high explosives and explosive devices with my current employer since about 1989, and have been dealing primarily with interactions of explosive materials in unusual chemical environments.

MR. WALTERS: Mr. Chairman, my name is Dennis Walters. I have degrees in electrical engineering and mathematics with emphasis in education. I have industrial experience as a maintenance and operations support engineering supervisor and manager. I have also been a manager of health and safety for a commercial utility and an operations manager at a waste energy plant. So I have both a safety emphasis as well as a production orientation in the way I think about life and the way we do business.

I have for the last five years been a management consultant through the Department of Energy, Office of Worker Safety, providing services to various Department of Energy sites, including in that process as accident investigation support. Thank you.

MR. PIATT: The role that Mike Failey played was as an expert in explosives safety and explosive chemistry. The role that Dennis Walters played was more looking at the safety management systems and how those were put in place, and how they interacted with this particular accident.

We also had three other team members who are not present today, and we would wish to recognize them. Susan Hale functioned as the safety analyst on our team to help us really focus on how do these facts, using analytical techniques, what do these facts really tell us as we pull together facts during the course of the accident investigation.

Cheri Foust, who was instrumental in a number of areas looking at some of the industrial hygiene issues originally going onto the site, as well as also considering some of the interactions with agencies and emergency response and a variety of things along that line.

Ken Harrington is manager of a group that has been working with industry for probably the last 20 years in chemical process safety, and so he was kind of the process safety expert on the team.

At this point I'd like to give you an overview of what we'll be presenting today. We essentially are going to, in a short capsulized version, go through the process of the investigation, talking about the facts of the accident which are derived from basically three sources: physical evidence that was collected on the site or examined on the site; the testimonial types of evidence which were gathered through the interviews of employees and the management people at

Sierra Chemical; and third would be kind of a documentation associated with this accident to basically tell us how they operate and do business at the site.

From that grouping of facts we did a methodical look at these facts in doing the analysis. We'll talk about some of the analysis, what do these facts mean once we collected them. We'll then talk about the dominant contributing causes that we saw, and then summarize the conclusions that were drawn from these things, which again I have to emphasize that this is still a draft report. It is based on the facts we have to date, and these are tentative conclusions and tentative judgments.

On January 7th, 1998, two explosions in rapid succession destroyed Sierra Chemical Company Kean Canyon plant near Mustang, Nevada, killing four workers and injuring three others. Because of the loss of life and the extensive damage, the Chemical Safety Board formed a team to investigate the explosion in an attempt to understand the causes of this incident.

The investigation focused on the sequence and the potential sources of ignition at the facility to identify the most likely initiating event and the equipment, management systems, manufacturing process, and human performance failures that might have led to the initiation.

At this point I'd like to also recognize that the team was not doing its work in a vacuum. There were other people working simultaneously, and to the maximum extent possible, we shared information with these other organizations in terms of the factual information that was being gathered day-to-day, and so we are really working off the shoulders of a lot bigger group than the team that we had on site ourselves.

I'd like to first talk about what it is that the Kean Canyon Plant manufactured in terms of what is an explosive booster. The explosive boosters that they manufactured are essentially about the -- varying sizes, but a nominal size about the size of a soda can, and could range from smaller than that to something up to two pounds of high explosives. We will take a look at a picture of what kind of -- a schematic look at what one of these boosters looks like.

Boosters are used by the mining industry, and when a blasting cap or detcore is inserted into the booster, it is then able to provide the necessary energy to detonate less sensitive blasting agents or other high explosives.

The picture that you see there shows essentially a cylinder, which is a cardboard cylinder.

The cylinder is composed of first an explosive mixture that is poured into that cardboard cylinder about two-thirds full called a base mix. Then a second explosive mixture called pentalite is poured and tops off the top of that cylinder.

Each cylinder has two small hollow tubes through the explosives, and this facilitates placements of the initiating devices, such as the blasting cap or detcore. The primary explosives used in the mixtures were composition B, TNT, and a third explosive called PETN. Other high explosives were often used interchangeably with composition B.

Next picture I'll look at shows the

production plant before the explosion.

CHAIRMAN HILL: Excuse me, John. You said that was about the size of a soda can?

MR. PIATT: Correct. As you can see from this photo, the production plant located in Kean Canyon is isolated by the public from steep hills and is in a relatively remote location. The plant is built on terraces at the base of this large hill at the background. It consists of a production building, PETN dry building, and small chemistry laboratory, lunch room, and several other trailers and tanks to store materials.

The explosive storage magazines are located off the screen to the left of this plant away from the main production facility. In the foreground you see a gravel pit that's operated under lease from Sierra Chemical by another company, but it's also located in this Kean Canyon area, south of the production plant.

Let's go to the next one, please. The production building was located on one of these terraces, and it's recessed into the next higher terrace. The building consists of several rooms that are separated by concrete block walls, concrete fill block walls. And we'll just look at these from left to right.

On the far left there you will see Booster Room 1, which contains the melt pour operations to actually pour these explosive mixes into the booster cylinders. To the right of that is a warehouse where some of the paper products that are used, like paper cylinders and other materials were used, and sometimes other materials were received there. I should mention that explosive materials were not stored in the warehouse but were stored in the magazine remote of this facility.

Next to that or adjacent to that in the same room is a change room, where worker change is below. That is the change room. There is a small office for keeping local records.

And then as we proceed to the adjacent

building, which was recessed back into the next terrace is Booster Room 2. This room also contains production facilities for manufacturing boosters, very similar to Booster Room 1.

Next to that is a room called the flux mixing room which manufactures a flux for the mining industry here. Beside that is a soda ash repackaging room which essentially breaks down large quantities of soda ash into bagged quantities for sale to commercial customer.

Finally to the right of that is a small boiler room and a tool room supporting this plant.

To the far right are trailers that were

parked that contained some of the materials used in the manufacture of the flux for the mining industry. So they are really chemical storage of both chemicals.

Above the rooms you see a variety of tanks. There is a couple of these bulk containers for the soda ash that have chutes that would go down into the soda ash repackaging room.

To the bottom of the drawing, the lines that you see are actually the separation between the various terraces. These are riprapped with heavy rocks on the slope of these that separates these various levels. On that second level down you see a small laboratory that was basically an R and D laboratory. You also see a lunch room, which was also the break room for employees working at this site.

At the very bottom is a building called a PETN drying building. We'll talk more about that. This room is used to dry one of the explosives that is shipped wet that is brought to the site and has to be dried out before it can be used.

In both booster rooms there are two melt pour lines that function in each of those rooms, and we'll also be pointing those out.

The accident investigation team conducted lengthy on-site investigation from essentially January

9th. They arrived on January 9th, and set up kind of a war room for us to work out of, and were on site conducting the investigation from January 10th through February 6th. The scope of the investigation team's responsibility was to examine and analyze the circumstances of the explosion, to try to learn what happened and attempt to determine the causes of the explosion.

The team evaluated the process design, looked at the safety management systems, determined their adequacy in controlling the causes of explosion. But the ultimate objective of this investigation is really to prevent similar events in the future. This event had already happened, but what could we learn from it to be able to prevent future events. And so the goal is to share those recommendations and lessons learned with industry workers and regulators.

The team used the following investigation methodology. First facts were gathered from the investigating evidence at the accident site, conducting interviews and review of existing documentation. As I said before, to minimize duplication of effort, we used information collected by other agencies to the maximum extent practical. Where other agencies had responsibility for chain of custody of the physical evidence, the team requested the physical evidence of interest be kept by the appropriate agencies, which included the Washoe County Sheriff and OSHA, Nevada OSHA.

In looking at laying out the evidence, one of the things that was done early on was to start to put together an events and causal factors chart which essentially lays out the sequences of events chronologically and shows related conditions that might have contributed to why those conditions existed. Because there were no survivors from the Booster Room 2, hypothetical events sequences were developed to test the feasibility of specific initiating events. An analysis of potential initiators was used to evaluate their relative likelihood.

A change analysis was used to identify those changes in operations on the day of the incident and also differences between the operations in Booster Room 1 and Booster Room 2 that might give us clues as to why an explosion might occur in Booster Room 2.

Finally we looked at a barrier analysis which was done to show the physical, administrative and management barriers that may have contributed to the explosion.

I'd like to now talk in more detail about the facility description to give you enough understanding of the facilities so that the rest of our presentation will be more meaningful. The Sierra Chemical Company explosive facility is located near Mustang, Nevada, approximately seven miles east of the company's headquarters in Sparks, Nevada. The facility is located on 640 acres of land.

It's isolated. It's north of Interstate 80. The chemical company has also leased land to Frahner Construction Company which operates a gravel pit there.

Kean Canyon is surrounded by a combination of public land, mostly managed by Bureau of Land Management and private property. The nearest permanent residents live over two miles away from the site that you see on the screen.

And because of the nature of the terrain there, this site is separated by intervening hills from any residences. Where you see the roads coming together down at the left edge of the screen, from the site, there is a locked gate that prevents access. There is also a chain link fence that goes up and around the road to the left and also across the lower edge of the facility below this gravel road.

All of the magazines and the buildings at Sierra Chemical Company were locked with either key locks or combination locks to restrict any access to the area because of the nature of their operations.

The Sierra Chemical Company plant, as I mentioned, produced not only boosters but other materials for the mining industry. The explosive melt pour operation manufactured the boosters. The Sierra Chemical Company also produced other materials for the mining industry.

As you can see, you can better see maybe the terraces on this set of or this illustration. At the very top terraces is a storage yard for excess equipment and materials that are not in use. The next terrace contained storage tanks for processed water and bulk soda ash.

The third terrace down had the main production building which included the booster rooms, warehouse and the chemical production facilities. The fourth terrace down had the chemistry laboratory, the employee break room and also employee parking near the break room. And fourth or then finally on the last terrace down, you can see the PETN building and its adjacent magazine.

The areas of interest where the explosions -- there were two explosions, as I indicated. One explosion took place in Booster Room 2. One explosion took place in the PETN building. So those were the primary areas of interest.

Also in this photograph you can see at the top the magazines that support this operation. There is a magazine at the very top upper right, kind of in its own little canyon area, and there is a second large magazine built into the hillside, essentially caves, as Mike is pointing to it there.

The difference in elevation between Booster Room 1 and PETN building is approximately 25 feet when you consider there's two terraces below separating those two facilities.

I'll talk a little bit more about the

production buildings. The building housing, this combination of buildings housing the booster manufacturing, the flux manufacturing or production and soda ash operations were really constructed over several years as kind of add-ons in an expanding operation. The explosive manufacturing buildings are fully grouted, reinforced eight inch concrete block construction. They had either asphalt or tar roofs supported by wooden trusses.

The warehouse in between these buildings is a prefabricated metal building. And then the PETN building is also a concrete structure, a reinforced concrete structure of concrete block construction.

We'll look first at Booster Room 1 in more detail so you can see internally what was going on there. The designs of Booster Room 1 and Booster Room 2 are similar in function. The Booster Room shown in this figure is approximately 40 feet by 40 feet. Access to the room was through the sliding door at the lower left of the building, or if you are coming from the warehouse, there is a personal door coming from the warehouse side there on the right side.

The sliding door at the lower left also was large enough to admit a forklift in there. The forklift typically would be removing finished product on pallets with finished boosters that had been boxed.

On the right side is another sliding door which would have access to a raised platform approximately four feet high and would bring in the raw explosive materials that would be used in the manufacturing process. These would be placed on this elevated platform for use the following day.

At the end of the shift the raw materials would be brought in in sufficient quantities for the next day's operation. Additional PETN, one of the explosives used, was stored in the upper left-hand corner in basically a small magazine which had been brought into the room to house that excess explosive.

Let me start over on the right-hand side of this room. There are three TNT melting pots that were used to keep a supply of liquid TNT available for the preparation of the mixes used in these boosters. These were kept hot constantly, and additional flaked TNT would be added to the pots as they started to use it up, so there was a constant supply of this. This was considered a means of efficiently making these boosters because the system in this room used a hot water heating system, and this way it would take less time to prepare their mixes having the TNT already in liquid form.

Going to the left you see a series of four melting or mixing pots that were used. And I would like to talk a little bit about what these mixing pots looked like. They are essentially a container within a container that is sealed so that within the shell of the two containers you could introduce the hot water in the outside or in this hot water jacket, and then the explosives would be placed inside the container, and that would provide the heat source to melt the explosives.

Starting from the top on this column of mixing pots was one pot they referred to as a small pot which was used for making the base mix that was used in the first pour of the boosters. The second mixing pot is the PETN pot. This was used by both lines, or both production lines in this room were shared, and this was the topping mix that was added at the top of the boosters. It is a little bit more energetic than the base mix and gave better performance for the boosters.

The third pot is also a base mix pot and finally is a pot used to melt composition B, which is one of the explosive ingredients. At the start of the first shift in the day, they would add composition B to this pot, so that as they progressed through the day, they would have liquid comp B ready to add to their base mix pots as they prepared that mix.

CHAIRMAN HILL: By more energetic, John, you mean more reactively explosive?

MR. PIATT: Yes. Slightly more sensitive, and it would make sure that you did get a good ignition of your booster. So it provided better performance.

The two octagonal things that you see on the screen are actually rotating tables. They are set up to place the booster cylinders on the table. They refer to this as setting the table.

As the mix is being prepared, and it takes that period of time for the mix to melt and be prepared, they would operate in teams in this room, and so one person is setting up the booster cylinders on the table. The table is like a lazy Susan in that it can swivel so that a person working at pouring the explosives only has to reach from the tap off of the mixing kettle into a pitcher, and he is actually working with like a two quart plastic pitcher, rotating the table as he needs to, to fill these empty cylinders for the booster pouring process.

Above each one of these tables is an air supply duct which essentially brings in cool air to blow across the top of the boosters. They are pouring in a liquid, just a liquid, just a little bit over the melting point of explosives in these boosters, and then as it cools, and with this extra cool air, they could then take off the boosters and place them in the cooling bins that you see as the next structure to the left.

Right behind that structure is a small mechanical conveyor that -- just a wheel conveyor that would then do their boxing operations, take the finished explosives, or the finished boosters, place them in the boxes, and then they would be placed on pallets to be removed from the room and taken back up into the magazines.

So that is the layout of Booster Room 1.

Booster Room 2, which had just recently been put into operation -- before I go, this is a photograph from Sierra Chemical that showed those octagonal tables.

You are looking kind of from the back corner of the room, and you can see the table with the booster cylinders. This table is fully set up, and he is now pouring one of the explosive mixtures into the boosters. In the background you can see the cooling bins, and you can also see the door on that south wall where the forklift would remove the completed boosters. As I said, they would operate in teams of two in this room.

Now let's look at Booster Room 2. Again, this room was approximately 40 by 40 feet. It had a number of similar types of features to Booster Room 1.

There is a raised platform on the back wall of this facility. Some of the pots, the mixing pots are on top of the platform. Some of them are just in front of the raised platform, or some were half way on, half way off. The explosives that would be brought in the previous day would be placed on the platform, placed between the two metal pots you see there on this raised platform for use.

Again, there are melting pots for the base mix and the melting pots that you see on the far outside, the pot 1, 2, 5 and 6 -- Mike, if you could point those out, please -- were intended for base mix production. The two center pots that you see were pentalite pots.

So each side of this room is essentially an independent process. There is no shared pots in this process. There is no melting pots.

And one of the advantages in this new room was that the steam heating system that supplied the heat to the mixing pots had a greater heat capacity, and could therefore melt the explosive materials faster. So there was not a need to have additional pots to keep a ready supply of melted constituents for these explosive mixes.

Here there is a large sliding door on the south wall. This provided the access for forklifts to be able to place explosives in here or to remove the boxed explosives when the boosters were completed. Again we have the two rotating tables, very similar design to the other room. We have cooling bins just below those.

And so the production process was you bring in your raw explosives, you go through your melting operations, you pour your boosters, the boosters are removed to the cooling bins, the completed boosters are then boxed, and then they would be removed to magazines back on the hillside.

CHAIRMAN HILL: John, just for clarification, this was a relatively new operation?

MR. PIATT: Correct.

CHAIRMAN HILL: Similar to --

MR. PIATT: Booster Room 1 had been active for over 20 years. In an expansion of this operation, we have this new facility which was only put into operation in September of 1997.

The pots that you see, the pots 1, 2, 5 and 6, were purchased excess from Hawthorne Army Depot. They are designed for explosives, melt pour operations. They are used pots. They were refurbished.

These pots are essentially, approximately 48 inches in diameter. They have an electric motor drive that goes through a gear reducer that is driving a mixer blade inside of it. It's kind of the shape of an anchor with a central shaft, and then the mixing blades, they came out from that shaft, go up inside the curved base of this mixing pot. And so this agitator is able to stir the explosive mixtures and get a good homogeneous mixture.

There's also in this pot two what they call breaker bars which stick down in the pot. These help the agitation process and keep any explosives from not being agitated improperly.

Steam was provided in the pot. It was provided in these, what they call the breaker bars. Steam was also provided to what they call a draw-off pipe at the bottom of the pot and to the valve where they would actually tap off the explosives into their pitchers to pour their explosives.

In this picture pots 1 and 6, the extreme right and left of these pots, had never been used. They had been placed there for expansion capability but had not been put in use at this point, at the point of this accident.

Pots 3 and 4 were purchased from an industrial food processing supplier. These pots are similar to the other pour pots. They are a little bit smaller. They are about 36-inch diameter. And stainless steel stirring mechanisms for agitation were fabricated locally for these two pots. Again, it is a similar type of shape. Kind of an anchor shape with the blade extending up along the inside of the pot from a central shaft.

Next I'd like to talk about -- okay. Let's take a look at an interior view provided by Sierra. Here you are looking from the back by the cooling bin. You can see, in the foreground you can see one of the tables. Down at the lower right, the table has got the rack set up that you would eventually place your cardboard cylinders over the top of those pegs. That would provide -- that would allow you to have the holes through the explosives. There is also a small sleeve that fits over each of those pegs.

In the background you can see the elevated platform. You can see an individual standing on the platform. You can see the dark mixing pot on the right. You can see the smaller stainless steel pot which was essentially one of these food processing types of kettles which had been adapted for this use. And then you can see how they staged their explosive materials between the sets of tanks or mixing pots in this room.

On the right you can actually see some of the completed boosters in the cooling bin, and you can see kind of that they do have that basic shape that we're talking about.

Though we don't have a detailed photo, I would like to look at the PETN drying building on this drawing and go back to the similar drawing that we looked at. PETN drying building consists of three rooms.

From left to right, the first room was a weather room that permits offloading material either that they had. Material that they needed to move in and they didn't have it already in their magazine, they could unload it directly off of a truck shipment coming in. They typically would be bringing the PETN down from one of the magazines.

The PETN when it is received is shipped wet with something in the order of 40 percent water in the

PETN. This makes it less sensitive and more safe for shipping purposes. So when it is received, one of the things that they need to do is to remove this moisture that it is shipped in.

It comes in a fiber container, fiberboard container drum, and inside that drum is the PETN packed in plastic bags. As they would bring it into the weather room, it would then be transferred from the plastic bags into canvas bags to allow the moisture to drip out of the bag first in what they call a drip room, which is the second room that you see on this as you go to the right.

After it had been transferred to the canvas bags, they then place it in a centrifuge much like you would have in your washing machine at home. It is designed to contain a number of these bags. They would spin those canvas bags which would dry out the moisture out of the bags, and so you would reduce the moisture content down to approximately three percent.

The bags, once they had been through the centrifuge, would be placed on racks in the third room, which is the drying room, and also in an adjacent magazine which had been adapted for use in this drying process.

At the far right of this building were two hot water radiators that had air blown through these radiators to provide your source of heat that would then be run through a series of baffles to these rooms to provide the heat to dry out the PETN.

The other commercial operation that I mentioned in talking about the Kean Canyon is Frahner Construction. Frahner Construction provides gravel and other materials for the construction industry. Frahner Construction also at this site maintains a fleet of heavy transfer vehicles that are used to haul these construction materials.

In the next figure we have kind of an overview of Kean Canyon. The grade that you see is color coded for your benefit. That is gray gravel. You are looking at a gravel pit.

To the right of that, the two yellow areas are a lower and upper parking area for these heavy vehicles that Frahner had on site. To give you some relative scale of distance, the distance from the Booster Room 2 down to the gate, which is at the juncture of the roads coming out from there at the base, right there, is approximately 380 feet.

I'd like to now talk about the incident description.

CHAIRMAN HILL: John, I think that is a good breaking point. It is about 10 after the hour. You have completed a description of the site.

We will go into a description, what did you say, of the process?

MR. PIATT: Of the actual incident.

CHAIRMAN HILL: Of the incident itself. Take a 10 minute break, come back at 20 after, and we'll pick up with that.

(Recess taken at 10:14 a.m.)

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RENO, NEVADA, THURSDAY, APRIL 16, 1998, 10:26 A.M.

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CHAIRMAN HILL: I'd like to resume the proceedings, if everyone could please take their seats.

I'd like to diverge just for a moment from the agenda that was passed out earlier in recognizing that we have been joined by Sheriff Kirkland here of Washoe County, as well as Captain Frank Barnes, who have joined us since we began. They have of course insight as to the initial response, appearing at the scene very very early after the explosion.

You just heard John Piatt describe the

facility. I think this is an appropriate point to go ahead and put that information on the record. So I'd like to call on Frank Barnes to provide his comments at this time. Frank.

MR. BARNES: Thank you, Mr. Chairman. I'm Captain Frank Barnes of the Washoe County Sheriff's Office, and I was one of the incident commanders on the Sierra Chemical explosion in Kean Canyon.

On Wednesday, January 7th, 1998, at about 7:58 a.m., an explosion occurred at the Sierra Chemical production facility in Kean Canyon east of Sparks. There was an emergency response by the Washoe County Sheriff's

Office. The Truckee Meadows Fire Protection District, Sparks Fire Department, Nevada Division of Forestry, the Reno Fire Department, Storey County Sheriff's Office, Nevada Highway Patrol, and Sparks Police Department all responded to provide assistance. There was an emergency response to the blast scene by law enforcement and fire service personnel. This response included an initial reconnaissance of the scene for survivors, victims and hazards.

Fires, explosions, unknown hazardous materials and uncertainty about unexploded explosives caused the emergency responders to be withdrawn from the scene. The incident command system was used, and the

Washoe County Sheriff's Office and Truckee Meadows Fire Protection District formed a unified command with multiple branches.

During the late morning, the emergency response efforts were directed towards assessing the danger and stability of the scene. This included aerial reconnaissance by the Sheriff's Office raid and helicopter and ground reconnaissance by representatives from the Fire District, the Sheriff's Office, Consolidated Bomb Squad, facility owner, and facility chemist. These efforts determined that the scene was reasonably safe from further high order explosions and could be reentered by proper equipment protected and trained personnel.

Combined teams of fire service personnel, hazardous material personnel, and bomb squad personnel reentered the scene in the afternoon. They searched for survivors and victims in all areas except those that were still too hazardous to enter.

The teams also identified and mitigated hazards, which included unexploded explosives, leaking propane and diesel fuel. No victims or survivors were found during these efforts.

At the same time that the emergency response was occurring, our investigation began. By the end of the first day, all survivors had been identified and located, and where possible, they were interviewed and statements obtained.

Also, all missing persons had been identified as well as their probable location and activity at the time of the explosion. At dusk, emergency response efforts were temporarily suspended for the day. The Sheriff's Office and Truckee Meadows Fire Protection District provided security at the blast scene throughout the night.

On Thursday, January 8th, the search for the missing persons or victims continued, as well as identification of mitigation of hazards that threatened the scene and the process of rendering the scene safe for investigators.

Detectives began to prepare missing persons reports and collect information on the missing persons. Late in the afternoon a victim was located in a hazardous area that could not be entered the day before. The victim was determined to be deceased.

However, potential explosive hazards were identified nearby, and the recovery of the victim was temporarily suspended. Security of the scene was maintained throughout the day and night by the Sheriff's Office.

The explosive hazard was monitored throughout the night using a forward looking infrared. By Friday morning the explosive hazard had significantly diminished, making almost all of the scene safe for investigators.

On Friday, January 9th, the unified command shifted from an emergency response to a joint criminal investigation of the Sheriff's Office and the Alcohol, Tobacco and Firearm national response team. Investigations were conducted at both the blast scene and away from the blast scene.

The blast scene investigation included, but was not limited to, looking at damage, blast effects, debris fields, and physical signs, photographing the scene, videotaping the scene, marking and recording the location of recovered human remains and other items of interest using sophisticated survey equipment, and the collection of human remains and articles or items of interest to the investigators.

The investigation away from the scene focused on interviewing survivors, witnesses and other persons claiming to have information relevant to the explosion. Samples were collected from the families of the missing men for later DNA analysis.

The Truckee Meadows Fire Protection District provided hazardous material and fire suppression support to the operations of the blast scene. The victim who was found late on Thursday afternoon was recovered and removed to the coroner's office for identification and autopsy.

Search dogs were brought in and used to search for the remaining victims or missing persons. A torso and other pieces of human remains were located by the search dogs in the afternoon. They, too, were recovered and removed to the coroner's office.

On Saturday and Sunday, January 10th and 11th, the Sheriff's Office and ATF joint criminal investigation continued at the blast scene as well as away from the blast scene. The search dogs continued to search the area for victims. However, only small pieces of human remains were recovered.

The blast scene investigation was completed at 5:00 p.m., on Sunday, January 11th, 1998.

On Monday, January 12th, 1998, the ATF national response team released its preliminary findings.

On Monday, January 12th, the search for the victims continued. Search dogs were again used throughout the day, but only a few pieces of human remains were recovered, less than had been recovered on the previous three days. The search for the victims was suspended at 5:00 p.m., on Monday, January 12th.

On Tuesday, January 13th, Governor Bob Miller toured the scene and held a press conference. After the press conference the Sheriff's Office turned the blast scene over to the Chemical Safety and Hazard Investigation Board and Nevada OSHA.

Throughout the time the Sheriff's Office had control of the blast scene, it maintained security of the scene, keeping unauthorized persons out and insuring the integrity of the scene for other investigatory and regulatory agencies.

Finally, from the first day and throughout the next week, the Sheriff's Office provided assistance to the families through the Truckee Meadows Law Enforcement Chaplaincy. This assistance included but was not limited to shelter at the scene, food, interpreters, transportation for family members, notifications of family members and survivors, and briefings on the emergency response and investigative actions. The chaplaincy also arranged for and coordinated a memorial service at the blast site on Wednesday afternoon, January 14th, 1998.

That concludes my statement.

CHAIRMAN HILL: Thank you, Captain Barnes. We certainly appreciate everything the local law enforcement did at the scene, particularly in preserving the scene and the cooperation that I personally observed and know that the team members received from your professional work at the site. Thank you very much.

I'd like to move back now to John Piatt and continue, now that we have had the scene described, with the portion dealing - correct me if I'm wrong, John - but with the actual event sequence.

MR. PIATT: Correct. I'd like to talk about the incident itself. As we mentioned earlier, there were two explosions that occurred at this facility. The first explosion occurred at 7:54 a.m. and was followed by a second larger explosion 3.7 seconds later as recorded by the seismology laboratory at the University of Nevada, Reno. They estimated the interval between explosions was accurate to within plus or minus two-tenths of a second.

One of the explosions occurred in Booster Room 2 and the other in the PETN drying building. The explosions involved a number of explosive materials, including PETN, composition B, and TNT, and perhaps some of the other military explosive compositions that were used in place of comp B as a substitute.

Sierra Chemical has estimated that based on an examination of an inventory done December 31st, and inventory of the explosives present following the explosion, that 47,000 pounds of explosives were believed to have been destroyed in the explosions and the subsequent fire. This material was divided between Booster Room 1, Booster Room 2, and the PETN building. Needless to say, there were thousands of pounds of explosives in each of these buildings.

In order to go back and look at the sequence of events, I'd like to start at the previous day. In the afternoon of that day, approximately 3:00 p.m., one of the melt pour operators for the west side of Booster Room 2 left work early, leaving 50 to a hundred pounds of explosives in mixing pot 5. He mentioned this to the other operator on the east side of the room working the second process line, who later checked and saw the explosives in the pot. That afternoon, the explosive raw materials were placed on a platform near the pots for the following day.

Operations began the next morning shortly after 6:00 a.m. in Booster Room 1. This is on January 7th, the day of the explosions.

The two teams -- the two workers each had finished their mixing operations for their first batch of explosive boosters for the day and were beginning to do their pouring operations. This placed two of the melt pour operators at each of the octagonal tables that we showed earlier, and while they were working on pouring the boosters or just starting to pour their boosters, another individual was in the room who was doing some boxing of finished explosives.

At this time I'd like to talk a little bit about the types, or the categories of people working at this site and talk a little bit about their roles and responsibilities. There are four classifications of people in the explosive operations at Kean Canyon, and these are the titles used at the Kean Canyon. There are the outside men, the melt pour operators, boxers, and the supervisor.

The outside men are paid an hourly rate and work normal shift hours. The melt pour operators and boxers were paid on production based on the number and type of boosters produced or boxed. And while melt pour operators worked nominal shift hours, operators could and often did extend their hours by coming in early or leaving late to increase their production.

The supervisor or plant manager at this site was salaried. Outside men were responsible for the PETN drying process that we described and for handling raw materials and finished goods, moving them to and from the magazines. They would stock the booster rooms once each day to ensure that the rooms had enough raw materials for all shifts on the next day's operation. They added TNT to the melting pots in Booster Room 1 to keep a constant supply of liquid TNT, and they were also responsible for loading and unloading the shipments of materials to and from the explosive magazine.

When sufficient reject boosters accumulated, the outside men would be responsible for breaking up the rejects to recover the explosives for reprocessing.

The boxers packed the finished boosters into boxes for storage and subsequent sale. They assisted the outside men in moving materials into and out of the Booster Room, and the boxers were paid on a production basis also.

The melt pour operators had various duties, depending on which of these rooms they were working in, and also depending on the experience of the individual. Normally the melt pour operator was responsible for starting up the mixing pots, preparing the two mixes, and pouring the mixes into the booster cylinders and then placing the finished boosters into the cooling bins.

The melt pour operators of the day shift in Booster Room 1 worked in teams of two. One operator would prepare the mixes, and the other individual, the other operator would be setting up the table to prepare for the pouring operation. Usually the more senior melt pour operator was responsible for preparing the mixes.

In Booster Room 2, on the other hand, there was only one individual working each line. The process is a little more efficient because of the steam heating system, so it only took one person in Booster Room 2.

CHAIRMAN HILL: This was the newer operation?

MR. PIATT: Correct. In Booster Room 1, they were working at this point with two shifts. So there is a day shift, and then there is a swing shift or back swift in the afternoon, basically a second shift that would leave approximately midnight, I guess.

The supervisor, who had over 20 years experience working with the company, oversaw the production on site. He was responsible for establishing the production runs, for monitoring work practices, for shipping and receiving materials, for cleanup, to make sure the cleanup was done, and for ensuring safety and quality of the product. The supervisor conducted tailgate safety meetings which emphasized housekeeping, sensitivity of possibly walking on spilled explosives, need to wash before eating, and also for not taking contaminated clothing home.

Because all personnel at Kean Canyon were Hispanic and most did not speak English, the supervisor was the principal translator and interface between management and the employees at the plant.

I'd like to go back and talk a little more about the sequence of events, now that we have identified who all the types of workers were at the site. The operations that began at 6:00 a.m. on the day of the accident started in Booster Room 1. The two teams of workers, as I said, were now pouring boosters at the two tables in Booster Room 1, and the boxer is packing finished explosives from the previous day's production.

At approximately 7:30, an operator from Booster Room 2 arrived at work, and came by Booster Room

1 just to greet his fellow workers who were in the pouring process. He spoke briefly with one of the Booster Room 1 operators and left the room approximately 7:35 a.m.

Shortly thereafter, the supervisor, who was actually on vacation that day, stopped by around 7:40 to 7:45 a.m., stopped in Booster Room 1 for about five minutes, then left and rode down to the Frahner gravel pit in a backhoe with another Sierra Chemical worker from the main office.

Of the three other workers in or around the production building, it is believed that one outside worker was in the change room between the two booster rooms, and he was waiting to clock in at 8:00 a.m., since he worked a regular shift. There was a boxer in Booster Room 2 packing finished boosters. And there was a third individual moving chemicals probably from the storage trailers to the flux room for production of the flux materials.

Also the Booster Room 1 -- or Booster Room 2 operator, after he had greeted his fellow workers over there, is believed to have been working on the platform behind the pots, as you can see on the Booster Room 2 drawing, probably at that point somewhere behind pots 4 and 5. The locations of these individuals are consistent with locations found from forensic evidence.

When the first blast occurred, a Booster Room 1 worker, the one boxing the explosives, saw outside a partially open sliding door a huge fire ball that involved a truck which had been parked just outside the sliding door. He was then thrown against the west wall, and then the ceiling and the east wall of the room collapsed, and it collapsed on top of him and the other four workers in the room.

Seconds later a second louder explosion occurred. The northwest and south walls of Booster Room 1 were still standing. However, the rest of the site was essentially leveled.

The site of the PETN building that you see on the screen ahead of us was now a crater approximately 40 feet wide and six feet deep. The explosions, these two explosions were felt as far away as 20 miles from the site. Debris in the vicinity of the warehouse change room and office was on fire.

And a second major fire involving truck trailers with containers of pelletized calcium hydrocholoride was burning in the south of Booster Room 2. If you can look at that picture taken shortly after the blast, you can see these two fires.

These produced, these fires produced the columns of black smoke that were seen by many witnesses on the day of the explosion. The five workers in Booster Room 1 were temporarily trapped in the collapsed building and debris but were able to crawl out within a few minutes. One worker was dragging out a co-worker who suffered a broken jaw and was unconscious.

Another worker was severely burned from hot TNT that had spilled in the blast, and a third worker suffered broken bones in his hand.

Concerned about possible additional explosions, the workers from Booster Room 1, after calling for other possible survivors, made their way down the hill to the entrance of the facility. There they met the two other workers working in the gravel pit, which again, as I said, is about 350 feet southwest of the PETN building. There was no evidence that the other four workers who were believed to have been in and around Booster Room 2 had survived the explosives at the point that they left the site.

There was a total of 11 Sierra Chemical Company employees on the site. We had the five people in Booster Room 1, the four people in and around Booster Room 2, and the two individuals working down at the gravel pit. Also on site at Kean Canyon was a truck mechanic from Frahner Construction who was approximately a thousand feet southeast of the production building in his truck at this time, and the second was a night watchman at the motor home approximately 900 feet from the building.

The legs from an empty tank which previously stood at the corner of the change room are shown embedded in his mobile home, as shown in this figure.

The blast effects from the explosion leveled the site and threw structural materials, manufacturing equipment and surrounding chemicals, water tanks, and raw materials from the booster and flux operations and other fragmentations up to a thousand yards away. The force of the PETN blast also broke a guy wire at a local power pole supplying power to the site, which caused the failure of power not only to this site but also in a housing development in Mustang.

The doors of one of the large magazines and a portable magazine located to the west of the production facility were sprung not by the initial positive pressure wave but by the negative pressure pulse that follows it. However, the large quantities of explosive materials that were stored inside these magazines did not detonate. In addition, many undetonated boosters were scattered throughout the site, as described by the Washoe County Sheriff.

Other hazards at this time included fires, toxic chemicals, and potential detonation of explosive materials in Booster Room 1 as the fire progressed.

Now you have just heard the description of the emergency response, so I will not repeat that. We'll just go on and talk about the first issue that was critical in our investigation. This was the determination of the sequence of explosions.

We'll be looking both at physical evidence and testimonies that provided the basis for this determination. As I mentioned, there were other investigations ongoing simultaneous with our investigation.

The Bureau of Alcohol, Tobacco and Firearms noted that the blast crater that formed from the PETN drying room exploded was essentially free of building debris from the booster production level of the plant. This was an indication that that blast happened second because of the absence of debris.

A second indication that they noted was that the plant, which was located in kind of a bowl in the hillside, has grassy slopes around the outside. And when first examined by BATF, the grass pointed regularly out from the PETN drying building and not from Booster Room 2. This indicated that the last blast came from the PETN building and not from Booster Room 2.

One area of layering that we looked at in terms of how materials from the blast were laid down on the ground was looking at a hot water boiler building which is in front of the west end of the warehouse and can be seen in this layout drawing. This is a concrete building with a concrete roof.

What was found in this layering was the door from Booster Room 1 was thrown out on the ground in front of the boiler building. The south wall of the boiler building was essentially blown through the building and landed on top of that door, and then the roof came down on top of that, giving us three layers of material.

When the sliding door was finally lifted, as you see in the photograph in front of you, there was no debris under it, even though it was surrounded by debris from the concrete hot water boiler building. This layering, like archaeological strata, indicate that the blast from Booster Room 2 which knocked down the wall between the warehouse and Booster Room 1 probably blew out the sliding door, which was to the raised platform of that mixing room one.

The second blast from the PETN building destroyed the hot water boiler building with its concrete roof falling done on the south wall, resulting in the strata found at this location.

A second point of evidence is the main body of a 12 foot diameter tank with a conical lower portion which was previously located at the southeast corner of the change room. This tank was blown directly south approximately 850 feet, where it landed on the north entrance road to the Frahner Construction lot. The steel pipe stand that supported this tank was also blown the same direction and was, from that previous photo, was what struck the mobile home housing the guard.

The top of the tank came to rest on the road northwest of the PETN building. Because this tank was elevated, it was fully exposed to the blast effects from the PETN building. Had the PETN building exploded first, this tank would have been propelled toward the Booster Room and adjacent flux mixing room.

However, the tank and its support legs were found on the far side of the PETN building from Booster Room 2. This provided additional indication that Booster Room 2 exploded before the PETN building exploded.

The next piece of physical evidence is a flatbed truck. This flatbed truck had been parked facing east on the terrace just outside the change room and office, and it came to rest on the riprap slope that separated the two terraces.

The driver's side of the engine of the cab of the truck showed multiple fragment penetrations from the blast from Booster Room 2. The passenger side of the truck shows blast damage that lifted the front of the cab off of the chassis as shown in this photo.

Next photo shows a pile of the riprap rock, heavy rock that is on the slope that was found on the uphill side of the driver's side front wheel. There was less material on the uphill side of the passenger side front wheel, but still some.

Also in the next photo, a steel cargo barrier, which had been welded to the front of the bed behind the driver, was found hanging from the bed on the driver's side on top of other blast debris in the vicinity of Booster Room 2.

The interpretation of all this evidence is that the front of the truck was initially struck by the blast from Booster Room 2, and the blast propelled the truck partially over the bank with the undercarriage resting on the brow of the slope. The blast then, from the PETN drying building, then struck the passenger side of the truck, which pushed up the front of the truck back uphill and caused the upward damage to the cab. This second blast also finally tore the cargo rack from the bed of the truck and deposited it on the uphill side of the truck on top of the building debris.

This blast tended to lift the passenger side of the vehicle, which resulted in more of the riprap being pushed uphill on the driver's side of the tire or driver's side tire.

Next piece of evidence I'd like to look at is the pickup truck that had been parked outside of Booster Room 1 that was seen by the boxer in that room. This truck was facing east initially and was found rolled over on the driver's side door following the incident. Both sides of the vehicle showed evidence of blast effects, with the passenger side having the greatest damage.

The driver's side door that you can see in this photo showed characteristic concave dishing from a blast. This could not have been caused by the rollover on the level ground. This evidence indicates that the first blast came from Booster Room 2 which caused this dishing on the door.

This was followed by a second blast from the PETN building which struck the passenger side of the vehicle and then rolled the vehicle over on its side. As you see it here, the truck had been rolled back over onto its wheels.

So the physical evidence indicates that the first explosion came from Booster Room 2. The time delay between explosions shows that the PETN building was not initiated by the direct passage of the blast shock wave from Booster Room 2 but was in fact a second independent detonation.

It is believed that in the rain of debris from Booster Room 2 that a heavy metal component or piece of debris from the initial blast went through or penetrated the roof or a skylight that was in that roof, into the PETN building and initiated a second explosion.

There were a number of identifiable components that we found in Booster Room 2, including table bases and several mixing pot shafts.

The next figure shows some of the original locations of these items in the room and the direction that each traveled following the explosion.

Item 1, the part that was found was the complete pot with the shaft intact in that pot. This is one of the pots that had not been put into use.

The second item was the full shaft assembly minus the mixing blades that are attached to the bottom of that shaft. I should say that the item number 1 was that whole pot was tossed 240 feet from its original location. The shaft from number 2, the full shaft assembly, which took approximately five or six people to lift when they took that in to be kept as evidence, was 675 feet from its original location.

We found one small shaft or one of the shafts from the small pots, and it is believed to be the mixing blade. We believe it to be the mixing blade from 3, although we have no conclusive way of identifying it. And that shaft was thrown essentially parallel to the direction of the right table base or in a parallel direction from that, and that was thrown 1250 feet from its original location.

Pot 5 that you see there was just a fragment, or it is an 18 inch piece of the top of the shaft of that pot, and that was thrown about 450 feet down into the gravel pit.

Item 6 had the pot lid and shaft assembly, also minus the mixing blade, and it was thrown about 480 feet to just south of one of the magazines.

Also the pot itself for number 6 was found just to the south of this room. And in looking at that, it looks like it may have careened off the wall which was built into that bank and ended up in that location.

Table base to the right was thrown about 455 feet. This is a steel base and a large steel shaft that allowed the table to pivot. The second table base was thrown 380 feet in the direction it showed.

If you follow back all of these arrows, you come to the conclusion that the blast was concentrated along the center of this north wall in Booster Room 2 where the explosives had been staged for this day's production. However, the presence of pot fragments and components in virtually all directions provides a possible indication that pot 5 exploded before the staged explosives on the platform.

In addition to the physical evidence, three witnesses provided information relevant to the sequence of explosions.

Out of the corner of his eye the worker boxing explosives in Booster Room 1 saw the fire ball coming over the pickup truck parked outside the sliding door. The sliding door was open, as I say, just wide enough for him to see this. It was open about wide enough for a person to walk out.

The blast from the first explosion threw him to the west, against the west wall of this building, and then the roof collapsed. He then heard a louder explosion.

The team believes that the fire ball that the worker saw was actually a fire ball caused from the explosion in Booster Room 2 and that the blast from that explosion which blew down the east wall of the room had sufficient force to throw the worker into the boxes on that west wall of the room. If the PETN building had exploded first, the blast, if not deflected by the terracing, would have thrown the worker against the north wall rather than the west wall.

The two Sierra Chemical Company employees who were working loading gravel in the gravel pit had the best opportunity to see the sequence of explosions. The next figure shows the view of the plant from this vicinity.

Neither employee happened to be looking directly at the plant when the first explosion occurred. One worker was facing the plant, heard the first explosion and saw dark smoke from the blast coming from the general vicinity of the change room. The second, brighter explosion was seen to the right of the first by this individual. From his vantage point, the PETN building was to the right of Booster Room 2. Thus, from his account, Booster Room 2 exploded first, and the PETN building exploded second.

The figure that you now see shown before you -- Mike, can you point out the truck that they are loading gravel into? The truck is on the right there.

This employee was located in front of the truck where you see the dot there. The line to the left of his line of sight and where he sees the first explosion and the line then to the right of that is the PETN crater. Thus, from his account, when he says he sees the second blast to the right of the first, that would coincide with the Booster Room 2 exploding first, PETN exploding second.

The second employee on the backhoe was facing away from the plant when he saw a flash of light out of the corner of his eye. He was driving over towards the gravel pile as the windows of his backhoe were blown out and he felt an explosion. He was turning his head and also heard the explosion at this point.

The effects of a detonation are as follows.

First is the light of the explosion, second the shock front moves through which also creates the sound. There's a positive pressure that moves approximately at the speed of sound, or positive pressure pulse that moves through, and then a negative pressure pulse. And finally the fifth thing that would happen would be the debris being blown from the blast.

The team believes that the effects experienced by this witness were all from the first explosion, at least that he witnessed. The distance from Booster Room 2 to his location was sufficient for approximately half a second differential between the sound and the blast effect and the original light that he saw out of the corner of his eye reflected.

There was insufficient time in his account of this event to account for the 3.7 second gap between explosions. Thus we believe that the second explosion occurred while this individual was exiting the backhoe and taking cover from falling debris.

Again, this drawing shows his position in a backhoe and his relative locations looking back toward Booster Room 1 and the PETN crater.

This concludes my remarks regarding the sequence of events and also brings us to the point of looking at the operating processes.

CHAIRMAN HILL: What would be your next presentation portions as we get deeper into the actual sequence of events, John? You have covered facility description. We have heard about the initial response from Captain Barnes. And now you have covered sequence of events of the explosion itself.

What are the next pieces you will be providing?

MR. PIATT: The next steps in our presentation are to look at the operations that are being conducted and some of the things that were concerns in these operations, as well as talking about the more detailed explosives that are used and a little bit more of a description of their characteristics.

CHAIRMAN HILL: Okay. I had one question. You mentioned rejects, reject boosters early in your presentation. Will that be covered later, exactly what those things are or why they exist, or can you provide --

MR. PIATT: I think I can answer that briefly.

CHAIRMAN HILL: Okay.

MR. PIATT: There are several reasons why they might have a reject booster. If explosives were spilled over the top of the boosters and they had a lot of explosive that had hardened on the outside, that might be one cause for a reject booster.

Second reason might be cracks in the explosive as it cools, it might be cracking. There might be, because they were poured, there might be separation between the two layers of explosive that could be detected.

There might be some other voids or imperfections in the surface that they might reject those boosters and just take them back for recycling.

CHAIRMAN HILL: So these things have to be fairly uniform before they are good product to be sold for the mining industry?

MR. PIATT: That's correct.

CHAIRMAN HILL: I would like to ask anybody at the three tables if you have any additional suggestions for inquiry or clarifications or any issues you would like to raise at this point regarding the three major items that have been discussed thus far this morning, including the facility description, the initial response, and the sequence of the explosion itself.

Is there anything at this time?

GENERAL CLARK: No, Mr. Chairman.

MR. BARNES: We concur with the comments he's made about the sequence of events. They are consistent with what we saw.

CHAIRMAN HILL: Mr. Swirczek.

MR. SWIRCZEK: No.

CHAIRMAN HILL: Obviously as more information becomes available, there will be more opportunity to comment on these issues as well.

Okay. I will then turn it back to you, John, and ask you to proceed with the operations of this facility itself will be your next topic.

MR. WALTERS: Mr. Chairman, this is Dennis now.

CHAIRMAN HILL: All right, Dennis.

MR. WALTERS: It is my turn in the barrel, as they say. Before I start with the formal discussion, I'd like to personally acknowledge -- I recognize the people at each of these tables -- that made it possible for us to have a productive and very professional setting to work in. As a visitor, the hospitality and professionalism of the groups was greatly appreciated.

I'm going to be covering right now some of the general operating procedures in the manufacturing of boosters, and after I cover that, then Mike Failey will come in and talk a little more detail about some of the specific activities that they do.

In Booster Room 1 -- if one of you could help me by pointing out where these areas are, that would be nice. In Booster Room 1 -- as John indicated, this facility has been in place for over 20 years. The operators in that facility are experienced in doing work that they are required to do in there, and they have been, most of the operators in the facility have been operators for greater than one year, and many of them have been operators for in excess of five to 10 years.

As John pointed out before, we have several mixing pots going in here. In a moment I'm going to talk about the sequence of bringing those pots on line, both at the beginning of a shift and at the morning shift, and also at the beginning of swing shift, because there is a difference between the way those two things are done, and that is significant later on in the discussions that we're going to be having.

The TNT melting pots, as John indicated, were left on. So there is liquid in there, and it is available to the operators at any time. The materials on hand again include dry flake TNT, PETN, the comp B or substitute material, which Mike will go through in a few minutes. Operation in that building started at about 6:00 a.m., and the second shift comes in about 3:00 p.m.

The basic steps in the process that these workers use differs with each of the operators that we interviewed. So there is not a consistent way, there is quite a varied way, and what I'm trying to do here is sort of generalize a composite process that is generally used. There will be individual differences throughout.

The sequence would begin normally with checking the pots for material. That would be the small pot, in Booster Room 1 it would be the small pot, the pentalite pot, the big pot and comp B pots.

CHAIRMAN HILL: You mean when a worker comes on in the morning?

MR. WALTERS: When they come in in the morning. Yet in some cases the people turn off the water in these pots. In other cases they do not. It might be necessary also to turn the hot water system on to these pots, depending on what the operation was or who was operating the previous swing shift.

In the next step in that process after turning the water on would then be to add, after they cleaned up the shop the previous evening, they have a bucket full of scrap material. That material is either poured in or has already been poured into one of the base mix pots.

They then add liquid TNT to the pots. I'm sorry. They turn the pots on, add the liquid TNT to the pots. The liquid TNT acts as a lubricant and helps to put the PETN in what we have identified as the PETN pot when they are making pentalite. They add the TNT first so that they can melt or put the PETN in suspension.

One of the steps they have to do, because of the composition, the characteristics of the composition of the material, is they have to break up clumps. Now not all composition B material has clumps, but some do and some don't. If there is a requirement for doing that, it's generally at the beginning of the process where they will break up those clumps.

The TNT is added to the pentalite pot, and then they add PETN. Basically in this section they have liquid TNT, and then they add the dry powdered PETN to the pentalite.

As John indicated, someone would also be doing the setup. The setup hasn't been completed yet, and so there will be kind of a delay between when we get the mixes started and when we actually started the melt pour operations. While it is heating up, the operators are preparing to do the pouring operation.

When the pots have heated up, the next step in the process is to add the dry flaked TNT to the base mix or the PETN pots, and that tends to cool the material to get it down to a consistency and temperature that makes it ideal for mixing. The operators and the management indicate that they are very proficient at maintaining and operating at that temperature. And as was said, that is just above the melting point of the material.

At 3:00 p.m., swing shift comes on, and since they are being paid by the number of boosters they produce each day, they basically take over the pots at that time and begin their set process.

Now when they arrive, they always would have a hot pot with maybe some material left in it, depending on how the previous shift had worked, and they would have the pot typically running, so the mixer would be running. And then they would take off from that step and pretty much follow similar procedures to what was being described before.

In those cases, because of that, they really didn't have to worry about checking the pot to make sure it was empty and that sort of thing. And at the end of the shift, they would normally leave all the pots empty. The mixing pots empty, the small pot, the PETN pot, the big pot, and the comp B pot would normally be left empty.

CHAIRMAN HILL: When does this swing shift conclude? Is it sometime late in the evening?

MR. WALTERS: Yeah. And they are not really on a clock on the swing shift. So they might work later hours or work to complete a reasonable production number to what was right for them. But it would normally be after 10:00 p.m.

Again, as I said, one of the things that the back shift guys would do is they would clean up the facility at the end of their operation and put the materials that they had picked up into the buckets. And there would be materials on the tables, table 1 and 2 where they were actually doing the pouring operation. When they get the boosters into the cooling bin, there's a place there where they would have some materials cleaning up the floor. And under the cooling bins there would be catch basins.

CHAIRMAN HILL: Is that normal, spillage of the liquid material as they are transporting it and putting it into the tubes, or is it dry material?

MR. WALTERS: It's typically dry material, and it is normal production.

In Booster Room 2, as we said, Booster Room 2 started operation on September 18th, 1997. That's approximately three months and a couple days, and a few days before the accident occurred.

Four of the pots, pots 2, 3, 4 and 5, were used in the production process. The large pots in this one, as John said, were used for base mix, the small pots for pentalite.

The steam system that heated these was a brand new steam system. It had a very high heat capacity, and what that means is it was able to provide a lot of heat, not necessarily high temperature, but act as a source of energy for this system.

The system was sized to operate both Booster Room 1 and eventually Booster Room 2. The intent was to upgrade Booster Room 1 to the location -- I'm sorry, I did that backwards. It was designed first to put -- for both rooms. It was initiated in Booster Room 2, and it was going to be added to Booster Room 1 subsequently.

CHAIRMAN HILL: I see.

MR. WALTERS: The system operates at 15 psig, which is a low pressure system as required or as recommended in this kind of facility. And that low pressure prevents the steam temperatures of going to any higher temperatures than approximately 240 degrees.

So this system operated at the same temperature, Booster Room 2, as in Booster Room 1, but because it had a higher heat capacity, it was able to melt material faster. This was considered a really important process step for the people working in that, and they had grown accustomed, in the few short months that they had been working, to it and really liked having that extra heat capacity because it streamlined their process and enabled them to get their melt going faster.

One other aspect of the design that was implemented here was that in pots 2 and 5 where the base mix was mixed, these pots had a much larger diameter or a substantially larger diameter than the mixing pots over in Booster Room 1. And that meant that the operators could mix fewer batches in order to get the same number of production units out the door. And they also liked that from that standpoint.

Now the operation was different in Booster Room 1. One of the primary operations that John has already talked about is there was one operator per side in Booster Room 2, where there would be two operators, melt pour operators working in tandem in a single line over in Booster Room 1. The initial process that should be followed here as described by the operators to us would be I should come in, check my pots, turn on the steam valves and turn the power on to that mixer.

There are five valves for each of the mixing pots. So turning the steam valves on was not a major task. It went pretty quickly, a matter of a couple of minutes.

They would add the scrap that they had to the base mix pot, which would be either pot 2 or pot 5. And then they would add comp B and other materials to the base mix and have that heating up. They would also at this time add PETN to the pentalite pot.

In this case one of the reasons they were doing that is that when there was wetter PETN at the site, the operators would -- the outside people were instructed to bring the wetter PETN to this facility because the added heat capacity enabled them to melt, to dry off, to cook off water and dry it out. So it was better able to handle moisture in the PETN than over in Booster Room 1.

After the pentalite had been mixing for a while and while the pentalite was mixing, they would then do their setup on the table. And the setup for the table would take approximately 40 minutes to an hour, somewhere in that time range to get ready to do the melt pour. And that was pretty much consistent with the ability of the pots to also bring a large mass of material to be melted, that they would be using to the proper temperature.

When the mixes were hot here just as in Booster Room 1, they would then add the powder TNT, flaked TNT to the mixtures and bring the temperatures down and then begin the melt pour operation. At that time they would generally reduce the steam to the kettles, because otherwise the temperatures would stay up too high and they would lose the temperature again. So they had to adjust the temperature at this point.

At the end of shift in Booster Room 2, the base mix and the pentalite pots would normally be left empty, as in Booster Room 1. In our analysis of this operation, the operational procedures for Booster Room 1 were written back in -- I'm sorry, I don't have that fact right in front of me with what I have, but we'll go over that in a minute -- were written sometime in the past when Booster Room 1 was started up, but were not available at the site.

And those procedures were written in English and not Spanish. The operators had not used those procedures in either developing their procedure or doing their training.

In essence, the operation is not controlled by any management system. The individuals are being encouraged to create processes that are efficient and able to produce boosters of high quality, and since they are being paid by that, there is incentive for them to be doing that.

The melt pour operators change their processes as they like. They did not require other outside reviews or independent oversight of those actions and might not even communicate to others what they were doing.

No independent review -- since there was no independent review of these changes, there was no opportunity for someone with other experience to question or raise issues that might be important to the operation system.

Also that meant that there was no review of safety impact going on. The training system, which I will be discussing a little later, is an on-the-job training process, and it did not really provide the operators with a background necessary to really have the technical ability to evaluate the impact of their actions on the safety of that operation.

So well-meaning operators would be making changes to the process to try to improve the quality, perhaps the safety, perhaps the efficiency of the operation, but would be doing so with a lack of information needed to do it effectively.

The differences in swing versus day shift -- I didn't mention this, but in Booster Room 2, they only operate a day shift. They don't operate a swing shift there. But the differences in the swing shift and day shift in Booster Room 1 that I want to point out here is that they didn't require in swing shift to do a startup of the pot itself. The process line just had to have more materials added to it.

And this affected the on-the-job training process because individuals being trained in their trade, how to be a melt pour operator, if they were trained on swing shift in their trade, they would not have to verify the condition of the pot, turn the valves on, and turn the pot on. Those are the first three steps of the normal process of starting up a cold line. And so even if it had been covered in the on-the-job training, it would not be practiced.

CHAIRMAN HILL: Because primarily the pots were already in operation?

MR. WALTERS: Yes. And so it wouldn't be

important for the operator. So intellectually, they may have heard it, but they wouldn't develop a performance habit of doing it that way every time.

CHAIRMAN HILL: It wasn't something you had to do on a daily basis?

MR. WALTERS: That's right. It would be a rare occasion that they would have to do that. The melt pour operator in Booster Room 2 that was operating in the room the day of the accident had learned his trade in Booster Room 1 on swing shift. He was considered to be a good operator and proficient at what he did. And he would normally leave his pot 5 and pot 4 empty at the end of shift.

I'm sorry. The dry air is getting me here.

He was the only person operating the pot. So he would also be the only individual that would be in that line, and so he would know the condition typically of his line at the beginning of shift from where he left it at the end of the previous day.

At this point, instead of drawing more conclusions on that, I'm going to turn over the discussion to Mike Failey, who is going to go into more detail on some of the process steps, and we'll come back to how this impacts the overall operation.

CHAIRMAN HILL: Okay. Thank you, Dennis.

MR. FAILEY: Thank you, Dennis.

Mr. Chairman, the first thing that I'm going to be looking at is a bit of a discussion on the high explosive raw materials that were used in the production of the boosters. The manufacture of the high explosive boosters involved the melting, mixing, blending and pouring of three energetic raw materials.

Two of the raw materials are single chemical compounds, and the third material is a blend of two energetic compounds plus a binder. The materials are TNT or 2,4,6 - trinitrotoluene, PETN, which is pentaerythritol tetranitrate, and comp B, which is a mixture of TNT and RDX, which is another explosive also known as hexahydro - 1,3,5 - trinitro - 1,3,5 - triazocine, or the royal demolition explosive. It also has other chemical names and common names as well.

The nominal composition of comp B is 63 percent RDX and 63 percent TNT, and it also contains a portion of wax, about one percent, which is a desensitizing agent and also helps in the blending process.

At Sierra Chemical, the composition B was purchased as surplus materials through the Department of Defense demilitarization program, or reclamation program. And what these materials are, the demilitarized explosives, they are explosives that are reclaimed from obsolete ordinates that might include torpedoes, bombs, rockets, mortar shells. The explosives are extracted by a variety of technologies, but usually melt pour operations where simply, the ordinance is heated, and the materials are poured out of that device or that bomb.

The explosives as supplied by the DOD come on an as is basis with no guarantee as to quality, purity, or impurities for that matter. So they may contain foreign objects.

Besides the comp B surplus material that was included in the manufacturing process, we have found that there were other reclaimed explosive compositions that were also used. In this first table, I have got a list of the explosives, some of the explosive compositions that were identified as being in the raw material inventory following the incident or the accident.

The explosives included: comp A-3; comp B; comp H-6; LX-14, which is also Livermore explosive 14, PBX-9404; which stands for plastic bonded explosive; Octol; and boxes of HMX, that may be HMX, but are more likely to have been labeled as HMX and actually LX-14 or some other high HMX content explosive.

If you take a look at those explosive formulations, you will notice that normal comp B is again

63 percent RDX and 36 percent TNT. Some of these compositions up here, like LX-14 and the PBX-9404, have no TNT present at all. They have the HMX present. There isn't any of the lower melting TNT present. And some of the other explosives like comp H-6 have additional additives that are a little bit unusual, such as aluminum powder of 20 percent approximately, wax and calcium chloride. That should be a subscript 2 on there.

Also I have listed some of the appearances of these explosives because they may give a clue as to what you are dealing with. On the other hand, many times all these blends look similar to a worker or somebody handling the materials.

For example, comp A-3 is white. Comp B can be white as well. LX-14 can be white, or it can have violet spots if it's lumped. And the violet spots actually come from an additive that's placed there intentionally to be able to identify it.

PBX-9404 is also white. So it's difficult in looking at these materials to know if you are dealing with something that is clearly different than what you are accustomed to.

CHAIRMAN HILL: Mike, you indicated that many of these compounds. Could you identify which ones are military surplus? All of those?

MR. FAILEY: All of these are military designated explosives, the A3HB6, and they are obtained from demilitarization programs or the destruction of obsolete ordinates. We'll take a look in just a moment at some of the properties of these individual chemical compounds, like the TNT and the RDX, but these things listed right here are military designated formulations.

Also I might add that there's on the PBX-9404, which has no TNT, there is also another additive, the nitrocellulose which acts as a binder in this case, and CEF, which chemical name is listed down below, which is pretty much a stabilizer for the nitrocellulose. It inhibits the breakdown of nitrocellulose with time.

There may or may not have been a compatibility issue with the CEF, chemical compatibility, but we'll go on.

CHAIRMAN HILL: You did mention that when the Department of Defense markets these materials, obviously using them for some meaningful purpose such as an industry as in this case, it is better than simply burning them to destroy them or discarding them in some way as waste. When they do that, it comes without any kind of guarantee that there might not be other materials within them?

MR. FAILEY: There are very limited or no specifications on the material. And the problem is if the military were to begin to provide a specification, where do they stop? Looking at purity, chemical purity.

There really is no specification on the material, and the problem has been that where do you stop in looking at chemical additives? Do you set standards for the size of the foreign objects that can be there, for the size of the fines or the powders, size of the particles that are present, size of the clumps? And many times, too, these materials are mixed or blended together or can be.

So there really are no fixed, well

established, quality control or product specifications, if you will.

CHAIRMAN HILL: Okay.

MR. FAILEY: Just difficult to do.

CHAIRMAN HILL: I understand.

MR. FAILEY: Besides the three compounds that I mentioned, the TNT, the RDX and the comp B, another explosive that was included in manufacturing these boosters is PETN. And if you put up the next table, we can take a look at the properties of these four basic energetic materials.

Now again, all of these energetic

materials -- well, all the demiled explosives will contain one of these first three, plus the PETN is used as another additive in production of the boosters.

Taking a look at this TNT to begin with, if you go across, I have got chemical names - we don't need to go through that - the properties. It appears as pale yellow crystals when it is flaked. Its density is about 1.65 grams per cubic centimeter, which just for comparison, water is one gram per cubic centimeter. That number will be important in just a moment.

Melting point of TNT is 80 degrees C. For RDX royal demolition explosive, it's colorless crystals, its density is a little bit later than TNT, 1.82 grams per cubic centimeter, and it melts considerably higher, at 204.

HMX, which is the abbreviation for Her Majesty's explosive, is a colorless crystal, its density is 1.96 grams per cubic centimeter, and it melts at 275 C.

PETN, colorless crystals, down below, density 1.76 grams per cubic centimeter, and a melting point of 141 C.

Now the significance of the melting points is -- the significance of the melting point is that only TNT actually melts in this process. If you have something like LX-14, which is 95 percent HMX with no TNT present, you are going to have great difficulty in trying to melt that material because it has a melting point of 275 degrees C, and we never get that high in the melting process, nor do you want to.

So anything that doesn't have TNT in it is inherently going to be difficult to blend and mix in the pots.

Moving on, with the density, the issue here is that once you have a kettle of molten material blended with TNT, RDX, HMX, PETN, if you then fail to agitate that or continue the blending process, you will get stratification in all likelihood. You will get areas where the RDH/HMX has settled. So you will have higher concentrations of those explosives relative to the bulk mix and a nonhomogeneous mix.

The importance there is that the TNT, besides being a solvent, a blending agent, also desensitizes to a degree the mix. So if you have got high concentrations of RDX/HMX, you may have an area of greater sensitivity as well in your mix.

CHAIRMAN HILL: So your last comment there, if you are not actively agitating and mixing this stuff on a constant basis, then you can get stratification, it will start to separate out like Jello or something?

MR. FAILEY: Yes, it will start to settle out. The heavier crystals will settle to the bottom of the mix.

Some other important properties that aren't listed up there but are clearly important to this discussion, first, TNT is largely recognized among those four explosives as the most insensitive of the explosives. It's considered one of the most insensitive military explosives available.

However, even given that, at room temperature the TNT has an impact sensitivity of 15 newtons per meter, which what that essentially corresponds to is it can be set off by the drop of a 4.4

pound weight, or a 4.4 pound hammer from a drop height of 14 inches.

At 80 degrees C, which is the melting point, the sensitivity is essentially twice that at room temperature. So a drop from approximately seven inches is sufficient to set that material off.

TNT is also sensitive to friction, although not very, just grinding or passing actions, and it's also sensitive to electrostatic discharge, especially if it's powdered.

RDX, just as a comparison, is about twice as sensitive to impact as TNT is, as is HMX. RDX and HMX are roughly the same, twice as sensitive. PETN on the other hand is about five times more sensitive to impact.

There is also another initiation mechanism, and that again is ignition by electrostatic discharge. And of these four explosives, PETN, especially when dry, is the most sensitive. And the sensitivity of PETN also goes up with temperature for electrostatic discharge.

In this process, we're not going to see it melt, but we are going to see it being heated to temperatures up to 80 C, which is increasing its sensitivity to electrostatic discharge from what it is at room temperature.

CHAIRMAN HILL: Where does one obtain these types of raw materials? You mentioned the others came from military surplus. What about the others?

MR. FAILEY: The PETN was obtained from a foreign manufacturer. The quality was considered very high. In fact, I have some previous experience with the source, and generally PETN from that foreign source is of a very high quality, very few impurities.

The flaked TNT that was added, what is the source? I don't know.

MR. WALTERS: The same.

MR. FAILEY: The same.

Well, that pretty much summarizes the

properties, the raw ingredients that are used and the properties of the individual chemical compound energetic materials. I'm now going to move on to some of the operational issues that we believe are important. And we will begin with just the operational issues beginning with breaking down rejected boosters.

One of the routine activities that would occur approximately every two or three months in Booster Room 1 was the breaking down of rejected boosters. And these are ones that again may have not had the proper fill. The process of breaking down the rejected boosters was performed when the total number accumulated to approximately 300.

The outside workers would break the boosters down in the northwest corner of Booster Room 1 by a small PETN magazine. And the breakdown process involved placing the rejected boosters in a block of wood or on the floor and striking the boosters with a hammer. A plastic hammer was available, a bronze hammer and a steel carpenter's hammer were available, and which one was used depended upon which one was available in the room at the time.

The chunks of the booster were then poured out of the cylinder into a pile on the floor. When the operation was completed, the scrap pieces of booster would be swept up with a synthetic bristle broom, picked up with a plastic dust pan and placed into a plastic bucket. Eventually the bucket was added back into the base mix for remelting.

Only two boxes of rejected boosters had accumulated in Booster Room 2 because of the limited time that room had been in operation. So it was not yet necessary to break down those boosters for reprocessing.

Analysis of this operation showed that breaking down the boosters created two conditions that could have resulted in a detonation. First of all, using a carpenter's hammer to break apart the boosters created a serious potential for an impact detonation or ignition from an impingement.

Secondly, the cleaning up process which involved the synthetic bristle broom and plastic dust pan and a plastic bucket created an ideal condition for static discharge.

Due to the timing of the activities that were occurring in Booster Room 2, the team, however, does not believe that the accident was caused by the breaking down of boosters because they had not accumulated to that point in Booster Room 2.

Another operational issue that we examined was the process of keeping the drawoff valves free of clogs by clearing them with various tools. The workers, regardless of the shifts, described two operating difficulties in Booster Room 1. The first issue was the difficulty of keeping the drawoff valves free from clogging, and a second issue which contributed to the first was the time that it took for the hot water to heat the pots and melt the materials.

The drawoff lines and valves, especially on the comp B pot and the large base mixing pot, clogged frequently. The clogging occurred several times daily on one or more of these pots.

Two tools generally were used to clean the clogged valves. The first tool was a wire handle from a plastic bucket that was looped at one end to help auger the material out of the valve. A second tool was a half inch diameter steel rod with a looped handle. And the working end of this tool had been honed to a sharp conical point so that it could be used to break up clogged material in the valves.

A plant manager at one point found this second tool, the half inch diameter rod, in Booster Room 1 on more than one occasion. When he found that tool in the process room, it would be taken back -- it would be taken back to the maintenance shop. A manager indicated that this tool should not be used in room -- should not be used in the booster rooms.

The melt pour workers indicated that it was sometimes very difficult to clear the valve, so they had to use more force. The steel rod tool would be used as a ram and would be jammed into the valve repeatedly until the mass of material broke free.

After this was accomplished, the tool had to be withdrawn quickly because of a hazard of being burned with molten liquid as the TNT was free to flow again. However, the clogging needed to be cleared because it stopped production.

The additional heat capacity and the separate steam jacket surrounding the drawoff valve in

Booster Room 2 mixing pots reduced the tendency in that room for clogging.

An analysis of this operation revealed that several explosive manufacturing incidents have occurred to the melt pour operations where metal tools such as the half inch diameter rod were used to forcefully break apart clogs in drawoff valves. We have included a list of some of these previous accidents in Appendix D. The management of the facility was aware of the potential hazards of this activity, but it was not effectively communicated to the melt pour operators.

Even when the half inch diameter steel rod was found in the booster rooms, employees were not made aware of the extreme hazard this type of activity created. Interviews with individuals showed that they believed they needed to use the tool, to use this tool regularly.

Although this work process was common in Booster Room 1, it was not common in Booster Room 2 because of the improvement in design in the drawoff valves. When the clogs formed in Booster Room 2, the melt pour operators could increase steam to the drawoff line and melt the clogged material within a few minutes.

Based upon the improvements in Booster Room 2, it's unlikely that the individual in Booster Room 2 would have had a reason to perform this hazardous activity on the morning of the accident. Therefore, the team does not consider this to be a direct cause of the accident.

CHAIRMAN HILL: You did say, Mike, that management at Sierra Chemical was aware that this type of practice had caused accidents in the past --

MR. FAILEY: That is correct.

CHAIRMAN HILL: -- and therefore had discouraged that practice?

MR. FAILEY: Another operational issue that we examined was breaking chunks of comp B materials.

This was a production issue that was faced by workers in Booster Room 1 more than in 2 because of the slow heat-up rate of the hot water system which would delay the pouring operation.

In the initial steps of filling the base mix pot, some liquid TNT was added followed by comp B. To compensate for the slow heat rate, the operators broke up large chunks of comp B, including the LX-14, PWX-9404, before they added the material to the base mix and the comp B pots.

Several techniques were used to do this. One worker described using a plastic mallet to break up the chunks in a box which was placed on other boxes on the floor. Most workers indicated that they used a carpenter's hammer to break up the material.

Another practice was to knock the pieces together over the pot feeding opening. Some workers described pouring some of the contents into a second empty box and then breaking up the contents with a carpenter's hammer. All workers indicated that there had been a recent increase in the size and the hardness of the chunks of the comp B materials that they were receiving.

Even though the system would heat approximately three times faster in Booster Room 2, the operators would still break the larger chunks of comp B or the substitute comp B's before they added it to the base mix pots. Occasionally, in Booster Room 1, following a power outage or hot water boiler failure, the hardened mix would be broken out of the mixing pot with a plastic hammer for later remelting.

In Booster Room 2, a wooden broom handle was periodically used for this purpose to knock off solidified explosives from the mixer shaft or the blades.

An examination or analysis of this operation of breaking up the chunks of comp B showed that this created a condition that could have resulted in a detonation. The process of using a carpenter's hammer or a bronze mallet to break apart large chunks creates a serious potential for an impact or impingement or spark ignition to the explosive material. The LX-14 that had only recently been introduced into the process had larger and harder chunks that would have required greater force to break apart.

Because of the practice of breaking up chunks using a hammer, one of the potential accident initiators -- excuse me -- one of the potential initiating conditions could have been that while breaking up the harder LX-14 to add to the mixing pot, the hammer impacting foreign material caused a detonation. It's also possible that there were foreign objects in the LX-14 that could have sparked or resulted in impingement of explosives when struck with the carpenter's hammer.

This work practice and the fact that there was no review of the use of the material in the melt pour operation demonstrates weakness in the control of the process. We considered this as a credible condition for causing the incident.

Another operational issue that we have addressed was foreign objects in the mixers, actually present in the mixers. The operators in Booster Room 1 indicated that it was common to find foreign materials in the comp B and the comp B substitutes. Most of the foreign material originated in the comp B.

The melt pour operators would typically use the handle of a plastic bucket to retrieve the foreign objects out of the kettle. The foreign objects included: nuts, bolts, screws, a conical shaped piece of copper which may have been the liner from a shaped charge, and aluminum posts from the booster mold trays. The posts ended up in a cleaning bucket after the floor was swept and were subsequently added to the base mix.

The foreign material that was recovered from the mixers would be discarded. These foreign objects were responsible for causing damage to the inner shell of the large base mix pot in Booster Room 1. The melt pour operators indicated that foreign objects were found in the mixers on nearly a monthly or more frequent basis.

Operators in Booster Room 2 also found foreign material in the base mix, but these items tended to end up in the boosters rather than remaining in the pots because the drawoff lines in the valves were larger in the new facility, so they would be thrown off with the liquid explosive.

CHAIRMAN HILL: So the foreign objects that were occasionally found in the pots would either come out the valve at the bottom, if they were small enough, or if they discovered they were in there, they just had to find some way of getting them out, fish them out?

MR. FAILEY: Of fishing them out.

An analysis of the foreign objects in the mixers indicated to us that metal objects created the high potential for detonation in the kettles due to friction or sparking of the foreign objects. The workers had become accustomed to hearing scraping noises in Booster Room 1 caused by foreign materials in the mixers. If the material left in the base pot in Booster Room 2, the night before, had partially melted before adding new comp B materials to the pot, it's possible that foreign objects in the material may have scraped along the inside of the pot causing friction which ignited the mix.

Another potential ignition source was that large chunks of material may have been caught between the mixing blade and the pot walls or the breaker bars, causing crystal shearing.

The last potential for ignition was the impact of chunks between the mixing blades and the walls of the breaker bars. The inner wall of the base mix pot in Booster Room 2 was made of three-eighths inch stainless steel. As a result, the system was more rigid than the approximately eighth-inch mixer wall thickness of the steel pots in Booster Room 1. This structural rigidity increased the potential for friction, shearing and impact.

Based upon the operating experiences described in the interviews, the presence of foreign objects and the surplus materials and the timing of the accident, this potential detonation source was considered a credible event and could not be eliminated.

Another operation that we examined was drying PETN -- pardon me -- another operation that we examined was leaving solidified materials in the pot at the start of the day shift. Once in recent months the swing shift crew in Booster Room 1 deviated from the normal end-of-the-work process by leaving approximately

50 pounds of material in the comp B pot. The material hardened over night, and this caused a delay for the crew in the morning of approximately three hours for the comp B to remelt.

The night before the explosion, a melt pour operator in Booster Room 2 left 50 to 100 pounds of explosive in the base mix pot that he was using. Leaving material in the mixing pot over night was a change to the usual way he operated, but it was an acceptable practice to alter the usual process without discussion or approval.

In fact, several months before the incident when material had been left in the comp B mixer pot in

Booster Room 1, management made it clear that this was an unacceptable practice because it caused delay in the operation of the day shift workers.

The facilities supervisor did not consider leaving the material in the pot to be a safety issue. Since the pots in Booster Room 2 heated material much faster, it is possible that the operator considered and determined that it would not be a production issue for him. He offered the remaining material in the base pot mix to a co-worker on the other production line in Booster Room 2 and may have mistakenly thought that the material that he left in the pot had been used.

It is likely -- we consider a credible scenario to be that the explosion occurred as a direct result of turning on the mixing pot blades in the morning while the pot contained 50 to 100 pounds of solidified base mix material in it. If this were to happen, material could be dragged around, a solid block of material dragged around with the mixing blade, creating friction between the solid mass and the pot wall. Or it could have created enough sheer energy in the material to cause it to shatter and initiate from the release of that energy on the shearing action. Or it may have involved banging and banging of the actual blocks of solidified explosive and dragging that between the mixing blade and the inside wall of the melting pot.

Another operation that we examined was drying the PETN in the pentalite mixing pot. One significant difference in the operations of the two booster rooms was that Booster Room 2, in Booster Room 2, PETN was added to the pentalite pot without first adding TNT. This was done to drive off residual moisture from the PETN. The supervisor indicated that Booster Room 2 was given the PETN with a higher moisture content because the system had a higher heating capacity.

The process of blending or stirring dried PETN is clearly a hazardous one. This increase in temperature of the PETN in the dry state clearly increases its sensitivity to initiation by electrostatic discharge, which is a potential cause of the accident.

Analysis of this operation by adding the PETN to the heated pot without the TNT as a solid lubricant, the operators were creating conditions that were ideal for generating static electricity or high friction in the pot.

PETN is more susceptible to electrostatic discharge, impact or friction, especially when dried. Since supervision at the facility had not observed the start-up processes in Booster Room 2 and there was no written procedure, there was no way for the supervisor to be aware that this was being done. The operators did not recognize the potential hazards of mixing PETN without first adding TNT which desensitizes the material.

This activity is considered to be one of the credible scenarios that could have caused the explosion in Booster Room 2.

Mr. Chairman, that concludes this portion.

CHAIRMAN HILL: Okay. Any additional information, John, or do you prefer that we pick up further analysis of this after lunch?

Of course, I do want to go to the various representatives available today to ask if they have any further insight or suggestions on what we have heard here today.

But first let me ask you if you have other materials to present after lunch.

MR. PIATT: We do have more materials. We would like to talk about the management control types of areas, the safety management systems that were in use. But this concludes this particular segment at this point.

CHAIRMAN HILL: At this time I'd like to go around to the tables then and ask if there are further comments, suggestions, or anything that you have heard that you would like to comment on or suggest things that you may not have heard in the presentation of the scenarios that the investigators have gone through with us today that you feel should be considered before the Board takes any further action. And we will have an additional opportunity for this later this afternoon. But anything you heard at this point in time you'd like to comment on?

GENERAL CLARK: No, Mr. Chairman.

MR. BARNES: No, Mr. Chairman.

MR. SWIRCZEK: Mr. Chairman, no comments at this time, but we will have comments.

CHAIRMAN HILL: Okay. Then since we're at a convenient breaking point and it is 12 noon, I'd like to recess until 1:30 this afternoon, and ask that everyone come back, and we will proceed with the additional safety management control portion of the presentation.

Thank you. We'll see you at 1:30.

(Recess taken at 12:05 p.m.)

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RENO, NEVADA, THURSDAY, APRIL 16, 1998, 1:36 P.M.

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CHAIRMAN HILL: I'd like to reconvene this meeting of the Board of Inquiry of the Chemical Safety Board.

Thank you all for returning after lunch. I hope it is a little more comfortable in here. It certainly is for me right now. So let us know if it gets too cool for anyone, but I'd like to go ahead and proceed with the continuance of presentation by the lead investigators.

I think we left off with looking at safety management controls was the next topic. Dennis, how many additional topics - maybe John has an answer to this - that we would be covering before closure of your overall presentation this afternoon?

MR. WALTERS: Gentlemen, if you would like --

MR. PIATT: We'll first be talking about some of the engineering controls that were present, especially focusing on the Booster Room 2 where we believe that this explosion was initiated. We will talk about first the engineering controls. Then we'll be looking at management controls. Then we will look and get a picture of kind of the status of regulatory oversight related to explosive operations.

The next thing we'll look at is some of the analytical types of things, just giving an overview and a sense of what types of analysis were done and just a brief summary of some of the results of those.

And then finally we will conclude looking at some of our tentative conclusions based on the information thus far and consideration of the judgments of needs that we see as a result of this accident in terms of preventing future accidents.

CHAIRMAN HILL: Okay. Who is going first? Dennis?

MR. WALTERS: Thank you, Mr. Chairman.

Before, or as I start here, there are some basic principles in safety management, and one of those is to identify the hazards. The second one would be eliminate those hazards that you can eliminate. Those hazards that can't be eliminated you then put in engineering controls. For those systems that engineering controls are not feasible, you then go into management controls, which include things like personal protective equipment and administrative controls and procedures and processes.

So as I lay out my next part of the

discussion, I want to start with the first piece would be to eliminate the hazard, but when you are working with highly hazardous material, eliminating the hazard would also eliminate the job. So it is not a practical solution here.

So we have taken up our -- the next part of the presentation starting with the engineering controls that have been put in place, and then I'll go into the management controls that are there or where the management controls exist.

Right now I will look at both the engineering controls initially. The engineering controls are always favored over management controls because engineering controls are a stronger barrier and are more consistent.

In Booster Room 2 it was designed with safety in mind. The management of the facility was trying to improve the safety of the operation, and in doing so, they were looking for ways to make the system easier to operate, make it more consistent.

A review of the design processes that they went through, some of the changes have already been discussed here. They put in improvements to the draw down valve, making the steam jacket go around the valve. The pots that were installed were installed with the kinds of electrical grounding that one would like to have in an explosive environment.

The motors and light fixtures were explosive proof motors and light fixtures. In essence, they were doing what would be considered good engineering practices and design and implementation, those types of activities. They had included a positive pressure ventilation system that would pressurize the attic area of that, of Booster Room 2.

That's important because it would maintain -- by maintaining a positive pressure, you would prevent dust particles from the explosive operation from getting up in there and accumulating and possibly creating an unsafe condition somewhere down the road. That was another positive thing that they had done in that section.

Again, the exhausting of the pots was actually better in Booster Room 2 than it was in Booster Room 1. As a consequence, the air quality based on conversation with the operators was better in Booster Room 2 than Booster Room 1. There was less dust and particulate. So that also indicated -- there was indication by the operators that they liked working in Booster Room 2 better than Booster Room 1, those that were working there.

CHAIRMAN HILL: So from a variety of standpoints, there had been a lot of upgrades that had gone into this construction in Booster Room 2?

MR. WALTERS: That is correct. Now I have to get to kind of the however piece of this presentation. There were also some features that were not present that needed to be present. One of those is static controls. In one of the analyses that they did, the process hazard analysis that was done previously for that kind of operation, static electricity was identified.

However, in the implementation of the design, they used nonconductive, epoxy, resin paint on the floor, which creates the potential for having a buildup of static charge on the floor. They had mats down which would be an electrostatic mat, which is a mat that is specifically designed to have conductivity so that a residual charge on a person or in the area can be dissipated to a grounding source.

But that only works if the mat is properly grounded to a grounding source. The mats that were in this facility were freestanding and did not have the necessary electrical connections to prevent the buildup of static electricity.

Another element that was not included in the design that should have been included was the provision for metal separation. Because they were getting the composition B material that had that kind of material, the foreign materials in it, having an effective way of removing those materials rather than letting them go through the process would have been a desired engineering improvement.

CHAIRMAN HILL: How would you do that?

MR. WALTERS: Some of the -- we discussed with some of the other industry representatives how they do it, and there are several approaches. One is to use a screen process where you sift the material through the screens. Another operator said that they used like a French fry basket and would put the material into a molten state and allow it to melt gradually in the basket.

So there were some industry practices that if they were generally available and if the management had known it, they probably would have put those in.

That, by the way, was the third piece that wasn't there, was the melting of the chunks because the way that -- they didn't make provision when they were having these large clumps of material in the composition B for finding a way to break that up in a safe manner.

There were two other, I guess I would say, building design issues. One of them had to do with the

PETN building, those three buildings that were located to the south of Booster Room 1. And that was a relatively new building, and it was built with cinder block or concrete block construction. And the cores of the blocks were reinforced with steel and concrete. Based on some of the evidence of materials that we found dispersed around the site after the accident, not every section of holes in the concrete blocks would have had rebar because we found pieces of concrete that clearly didn't have rebar going through them.

But the Department of Defense considers that to be a poor design practice because of the secondary fragmentations that occurs in an explosion, the concrete blocks break up, the core sections are then available to move out. And you can find those kinds of materials hundreds of yards away.

I think in our analysis we believe that the management of the organization -- of Sierra Chemical did in fact intend to do a safe design. The design features that were there were not sufficient to prevent operations of mixers with materials in a pot. That would have been another design feature that could be considered. I don't know of an existing design that does that, but it doesn't preclude the possibility of doing it.

The skylight that was installed in the PETN building, which was another design feature of the PETN building, in order to have improved light in the building, and not have to have more light bulbs in there, they had put a skylight in part of the building. That skylight allowed a path for fragmentation pieces to come through the overhead potentially and come down. That may have been a source of the detonation in the PETN building is material coming through the skylight.

The next area I want to talk about is management controls, and I will try to not go through these in too much detail, because they will be in greater detail in the report, and in the appendices there is also more detail than I'm provide right now. But the management controls that we were looking at are management controls that are identified in process safety management. They would be specifically the ones I'm going to discuss right now. Employee participation, process hazard analysis, operating procedures, training, management of change, management oversight, pay policy and documentation. I'll try not to do this all in one breath.

The participation -- I want to start with employee participation program. Sierra Chemical had a documented program, and in that program it provided management's expectations. It included the safety responsibilities of the individuals working there as well as the employee rights. This document under responsibilities had responsibilities such as a worker had the responsibility to know and follow the rules, wear protective equipment, report injuries, report unsafe conditions, follow the job procedures.

The employees's rights included things such as safety and health, having the right to a safe and healthful work place, having the right to safety training, both general safety and specific to the work that they are doing, and having material safety data sheet information as well.

In conducting interviews with the workers and management, we determined that -- we believe that the employee participation program does not adequately require and allow participation of the workers at the Kean Canyon facility. There were no operations people involved in helping to prepare the programs, the policies or the procedures. They were done from the corporate office instead of in conjunction with the workers at the facility.

Workers were not familiar with the program, and in some cases they didn't know it even existed. So that demonstrated that it really hadn't been adequately integrated into the operation of the facility as well.

There was an awareness of some explosive hazards, and there had been a lot of emphasis placed on housekeeping, fire protection, use of dust masks to protect respiratory problems, and clothing control. And the clothing control was to prevent moving contaminated material back to the home and so forth.

The workers were told to report safety problems and issues, but there wasn't really an effective process in place to do that. They weren't given the detailed information to implement that they would need in order to know how to address those issues effectively.

There was a lack of participation, I think in part because of a lack of recognition of the hazards that they were working with. This system, by not having adequate participation of the workers at the facility, you lose an opportunity to train the workers on the importance of it and to gain valuable feedback on how the workers understand and are able to do these things. As a consequence, we consider this to be a contributor to the accident that occurred on January 7th.

The next area I want to cover is process hazard analysis. Process hazard analysis is an element of the process safety management requirements under OSHA, and its purpose is to insure that hazards are adequately identified and controlled to create that safe work haven, and it's specifically addressed and it's specifically targeted at chemical industries.

Sierra Chemical Company conducted a process hazard analysis of the booster manufacturing process in Booster Room 1, and on-site transportation and storage. Those two documents, Booster Room 1 came out in December of 1993, and the transportation and storage process hazard analysis came out in May of 1994.

Sierra Chemical used what's called a "what if" analysis. In that process you consider some of the types of accidents that are likely to occur, and then you look at the processes, the engineering features -- I'm sorry -- the engineering features and then the processes that you would use to prevent that from happening. The team that put this safety analysis together was comprised of four individuals: the president of the company, the vice president of explosives, the compliance engineering manager, and a process safety management specialist who is no longer with the company.

There was no separate process hazard analysis done when Booster Room 2 was put into operation prior to designing and implementing Booster Room 2. That was done based on interviews because management felt it was a similar operation, and therefore, a new process hazard analysis was not necessary.

The original process hazard analysis for Booster Room 1 covered 11 significant issues: moisture, spillage, high temperature, static electricity, fire, hydraulic system failure. In Booster Room 1 they had hydraulic systems operating the mixer motors, exothermic reactions, and I'll describe that in a little bit, lightning, scrap metal contamination, stuck valves, and power failure.

This safety analysis in fact did cover most of the incidents and precursors that one would expect to find. However, there were some deficiencies in the analyses.

One notable one was that there is an element of human factors that is part of every hazard analysis. And when you look for failures in systems, most failure or very high percentage of the time human failure is a significant factor in accident initiation events. We're used to hearing it in terms of pilot error in the media oftentimes.

The human factors area was only discussed generically in the process hazard analysis. It did not consider specific types of human failures that could occur related to the operations at Kean Canyon.

The process hazard analysis also did not address co-located operations. By that the flux and soda ash operations that were taking place were not part of the manufacturing of explosives, but the workers in those operations were exposed to the same risks as those workers that were required to work with the hazardous materials.

CHAIRMAN HILL: Dennis, did this process hazards analysis deal with those four particular job descriptions that were outlined by John earlier, looking at them separately?

MR. WALTERS: Generally that is not the way hazard analysis is set up, although it would look at operating practices, for instance, and not look at individual contributors to the process.

Also there was no information or no -- there was no coverage in the process hazard analysis on how process safety information would be handled. And by that, managing information is important because you need to be able to take lessons learned from other organizations, you need to be able to take what you find in your operating practices and convert those into meaningful communications to help the operators do their job better and to continue making the operation safer as you operate it.

The other element that was not adequately addressed in the process hazard analysis was the facilities siting, and the element that relates to that has to do with the quantity distance kinds of criteria that were identified, and I'll cover that I think a little bit later. But the quantity distance issue is that from the Institute of Manufacturers, Makers of Explosives. IME has a criterion document which is not a regulation or a standard but is a good industry practice. In there it has quantity distances based on the explosive loading and so forth.

The facilities between Booster Room 2 and Booster Room 1 and also between Booster Room 2 and the PETN building did not meet that criteria.

Once the process hazard analysis has been completed, the next step in the process would be to implement those actions and controls that will bring the level of safety that you desire to have. The implementation of process hazard analysis, there are some deficiencies in the way it was being implemented. The hazard control procedures were communicated in safety meetings and also some in general training.

Documentation shows that the primary emphasis again was on those things that actually the people had a pretty good understanding of, housekeeping, clothing, that they are not allowed to smoke in the area, those kinds of things. It really didn't do an adequate job of talking about the other risks involved with handling materials, such as Dr. Failey talked about this morning.

Excuse me just a moment.

CHAIRMAN HILL: Certainly.

MR. WALTERS: Another element was that while management had become aware of some other industry incidents that would have been important to update the process in hazard analysis, and to include in operating procedures and in training processes, this kind of information was not effectively integrated into the operation. There is no formal process at the facility to apply lessons learned.

And also because the Kean Canyon workers were not involved in the development of the process hazard analysis, they lost an opportunity to have input and also to gain greater insight into the hazards that were involved in their work place. The workers were not familiar with the hazards or the controls, and there are several examples of that. The static electricity and potential for static discharge causing detonation was not generally recognized, not only by the workers but also by members of management.

They did not have effective controls in place to handle the kinds of accidents that had been considered in the process hazard analysis. An example of that is with this thing that was called exothermic reaction.

Some years back, approximately 1984 time frame, the Sierra Chemical received a batch of explosive materials that were used in manufacturing. I believe it was from an Iron Curtain country. And that material reacted chemically with the other materials that go into the booster.

An exothermic reaction is one where two chemicals when combined create heat and give off heat. In this particular case, a brownish red smoke is created, which - I'm not a chemist, so I'm on the edge of my competence here - but the brownish red haze is I think a nitrous oxide or has to do with nitrous -- help me here.

MR. FAILEY: Notrogen dioxide.

MR. WALTERS: Nitrogen dioxide. He likes to do that. He also likes to draw the molecule for us.

CHAIRMAN HILL: It helps to have a chemist.

MR. WALTERS: But in any case, the vice president of explosives for the company was working on the process line at that time. He had learned the operation as a melt pour operator, and when he saw this occur, the smoke start to occur, he realized that there was a problem. And he dumped the material on the floor, washed it with water.

Now that process was described in the process hazard analysis as being the appropriate action to take in the event that a chemical reaction like that would occur. By the way, based on the accidents back in I believe it's Appendix D that are discussed, this same reaction has occurred, and if not corrected, ends up with eventually a detonation of the material in the pot. So it is a real issue and has a documented accident scenario where that occurred.

In interviewing the operators of the facility, though, none of the operators that we talked to were aware of any such condition occurring. And in fact, they would have seen an increase in temperature as causing the material that they were working to get hotter. As it got hotter, its pouring consistency would get less dense, and it would tend to be too fluid for pouring effectively. And their operating action, which was indicated by several of the operators, would be to add more powder TNT to the batch to bring the temperature back down, which could have had bad consequences.

CHAIRMAN HILL: Are you saying that that had not been observed recently by any of the employees?

MR. WALTERS: Yes. In fact, thank you, I wanted to make that clear. This situation was particular to a manufacturer that they were getting materials from. They stopped getting materials from that manufacturer. They have not since 1984 had a similar reaction.

CHAIRMAN HILL: Okay.

MR. WALTERS: What I do want to point out is that it was something that is possible. It had happened at the facility. And it was not included in the operating procedures or the training program to be aware of it and what actions to take.

I would also say we do not believe that that was a potential cause of this problem of the accident on January 7th.

But it goes to show how deficiencies or how the integration of that information, the identification of the hazard and the control of the hazard, that link was not working.

The other example of this is the clogged drain off valves over in Booster Room 1. No means had really been determined to control that, and the operators were not adequately dealing with that hazard in a safe manner.

There are some other examples that are in the text that I'm not going to go into right now. But they are similar cases where a hazard was recognized, and then we didn't have the right controls in place to resolve that.

Failure to adequately analyze and control the hazards, though, was a contributor to the January 7th accident.

The next element I want to talk about is operating procedures. We have covered this some in detail or some already. So I'm going to kind of breeze through here.

The procedures written for Booster Room 1 were not specific to that booster room on both shifts. The procedures also did not identify modes of operation or the emergency or what to do in the event of emergencies. Operators had not seen a procedure, and there was no copy of the procedure on the site.

It was not used as the basis for operation, nor for training. And as a consequence, there was considerable variation between the way individual operators operated the facility.

Since no operating procedures were provided, we could not -- the system did not ensure consistent, safe, melt pour operations. The workers were not -- the procedures were not available and so weren't used in doing training, which also means that the training was not consistently applied. And the procedures used in the melt pour operation were largely left up to the individual operator, as we have said before.

Management procedures are a tool to control the operation. And as a result, we consider the lack of written procedures to be a contributor for the January 7th accident.

The next element I'd like to talk about is training. On-the-job training was the primary method of preparing workers to perform the melt pour operations. And as I said previously, this training was pretty much left up to the -- what was trained was left up to the prerogative of the experienced operator who was giving the training.

The basic steps were the training was first, as to watch the operation and was then allowed to perform certain tasks under direct supervision. Once the training operator felt that the trainee had reached a level of performance that was adequate, he would then allow the person to do that operation without supervision.

CHAIRMAN HILL: So it was basically on the job types of training?

MR. WALTERS: Yes.

CHAIRMAN HILL: Was there any other variety offered to new employees?

MR. WALTERS: Yes, there was. The other

type of training that I will cover in just a little bit. There is kind of a generic safety training as well.

But the on-the-job training is the most significant in terms of the incident here because it's the basis by which the experience and the knowledge is generated, is carried from one generation to the next. And each time it transfers from one generation to the next, information is lost, and also habits that may have been picked up in the meantime are passed on.

So in one sense, we could lose good information, and in another, we could add poor practices as a result of not having a system, a process that is well documented and follows a check list and a standard and a criteria.

Basically what we have here is that because it wasn't a documented process, it was totally reliant on what I would call kind of tribal knowledge to pass from one generation to the next.

Now one of the positive pieces, I guess - kind of give a little balance here - there were people that were doing this kind of training that had eight or nine years' experience doing this work, and so there was a -- to the level of knowledge they had, they were competent in doing what they were doing. I think as I'll go into a little bit later, I think the level of knowledge they had was not sufficient to do the work, though.

Interviews showed again that in this process that the workers, that we emphasized housekeeping. There was also emphasis on never leaving the pot with material in it. And there was discussion of looking into the pot.

However, in interviews where we interviewed the operators on an individual basis, I think in only one instance of about six or seven interviews did someone say that the first step before turning the pot on in the morning was to look in the pot. When prompted with that requirement, all of the operators said, oh, yes, that's a good thing to do, you should do that. But none of the operators in describing the detailed process, except for one, gave us that information up front.

The on-the-job training program use of facility lacked formality, and the technical basis needed to ensure that potential hazards in the operation were adequately controlled. Because the program relies on oral communications, physical demonstration, the senior operators' experience and expectations, and does not have a technical basis or information that one could go to later, there was not an assurance for management that the individuals were getting the right information and would take the right actions to ensure the safety of the operation.

Without those procedures and check lists, standards or performance criteria being used in the training, the content and acceptable performance is left to the discretion of the trainer, and the training program does not ensure the workers who have gone through the program have a consistent understanding of what is expected.

That completes the specific training issues of on-the-job training. It's important for us to say here that we think that on-the-job training is an excellent way and could be effective with the type of work that was being done and with the workers and the experience in the work force. But because of these pieces, the formality and the basis necessary to ensure consistency, that that system failed in that area.

The general safety training is the next area I want to talk about. As has been said previously, Spanish was the only language comprehended by a majority of the operating staff of the facility. When company training was provided in a generic sense, it was conducted in English and then translated to Spanish, usually by the supervisor of the Kean Canyon facility. But there were three other operators at the facility that spoke and read English as well as Spanish.

Generally when they were testing to see whether or not individuals understood the information that was being provided, those tests were written in English. The supervisor translated the tests for the workers, and then translated the workers' response back to the test.

Generic OSHA training program was also evident in the training, the materials that they had at the main facility, and some of those -- included in that were Spanish language videotapes of some generic operations issues such as lockout, tagout, would be an example of one of those tapes.

The production supervisor -- I'm sorry.

Again, this issue of language I think has an important -- is important to what's happening because none of the policies, procedures or training aids of the facility were written in Spanish for those people that had Spanish as a primary language. And some, as their only language, would not be able to reference back to those materials that would otherwise be available to the normal worker to get questions resolved and try and understand what was being asked of them.

Examples of that include the material safety data sheets as well. They would receive training in the material safety data sheets, but they would not necessarily have those available to them in Spanish.

This lack of written procedures, having a language that is understood -- that is not understood by the workers, and the inability of management to be able to communicate directly, senior management to be able to communicate directly with the workers in their language, we considered all these to be contributors to the January 7th accident.

As an offshoot of this training piece, I would like to share one other practice that was done. The supervisor at the facility on almost a daily basis did explosives demonstrations. It was part of the process of verifying the quality of the boosters. And that was done in a location away from where the work was being performed.

But what he would do on that is he would invite members of the melt pour staff or the outside operators or the boxers to come with him during these tests so that they would get an idea of what the product is and how volatile it is. The workers understood that the boosters were explosive, and I think this was a good practice for him to do that.

What we couldn't find in the process, again because of the lack of formality, there was no documentation to show what kinds of specific information was being discussed, and so, we can't really be sure what the operators learned about the importance and how to handle the material as a result of seeing these demonstrations.

The materials used to make boosters require a high degree of formality because of the consequences of failure to manage them if you don't manage the hazard adequately. During the interviews it became clear that there were deficiencies on the line manager's and supervisor's technical understanding of why work precautions were necessary when working with these explosive materials.

As a result, the process hazard analysis was not comprehensive and did not include the potential event believed to have caused this accident. Line manager's understanding of explosive hazards were influenced primarily by their own operating experience rather than industrywide experience. Even though the process hazard analysis and product line literature identified potential hazards leading to explosions, management believed that short of using a blasting cap, it was almost impossible to detonate the explosive materials that were used in the process.

This demonstrates a false sense of safety in the work place and in the work practices followed by the facility. Managers emphasized housekeeping as their primary safety concern. Management did not prepare the process hazard analysis or integrate it adequately into the work practices so that it became a meaningful task.

CHAIRMAN HILL: Dennis, you said earlier that there were demonstrations of what I took to be detonations?

MR. WALTERS: Correct.

CHAIRMAN HILL: Very routinely. How were those done? What caused the detonations?

MR. WALTERS: Those were done using blasting caps and in an industry acceptable manner.

CHAIRMAN HILL: Were those done on site or near the site?

MR. WALTERS: They were done on site. Just a second, John can maybe post one of the documents that shows that.

John, can you point out on that chart where it is that they did the work?

MR. PIATT: There is a canyon back up here, and they would go back up a road back up here in this canyon to do these tests, and would do one booster at a time.

MR. WALTERS: So they had adequate control to prevent a propagation of a detonation from there to the others, and when we discussed that with people, we felt that what they were doing was adequate.

CHAIRMAN HILL: Okay.

MR. WALTERS: I think it might be a good point right now to point this out, especially to people that are listening to us. The purpose of accident investigation is to understand what went wrong, not what went right. So there are many things that were being done right here, but as we're describing what we're seeing, we're describing what's wrong because that's what we want to improve.

CHAIRMAN HILL: Absolutely. Very good point.

MR. WALTERS: The next area that I want to go into very briefly is management of change. One of the elements of effective control is to be able to deal with new processes, new information in a way that will ensure that the safety is maintained and enhanced.

As a process, when they went to do the design change to Booster Room 2, the management did not effectively manage the change. And the reason I'm saying that is that they didn't adequately identify some of the new accident modes that may be created by going, switching from a hydraulic system to an electrical system, for instance. The overall process is very similar, but there were differences as a result of that.

As Mike had indicated in part of his presentation, the rigidity of this, of the mixing pots, the large mixing pots in Booster Room 2 created a new form of a new possible detonation source.

CHAIRMAN HILL: Okay.

MR. WALTERS: There was no evidence that the changes that were being implemented were really evaluated to determine how they would impact the assumptions that were made under the process hazard analysis.

I'm sorry, I missed a section on training that I needed to go back to just for a moment, and under the analysis. Sierra Chemical is a member of the

Institute of Makers of Explosives, and in fact, the president of the company I believe is on the board. However, what we have determined in interviews with members of that company is that they rely on their personal experience at the operations of Kean Canyon rather than on industry experience that would be of broader base.

There is a problem created by the fact that there is no certification process industrywide to say what does a manufacturer need to know, what skills, what knowledge, what capabilities does he need to have in order to operate safely. There are some guidelines on some of this information. But there is no standard.

So there's no reasonable way -- or I'm not going to say that. Excuse me. There is great difficulty in doing a self-evaluation to say am I doing all the things I need to do when there is no standard by which to judge that that's been addressed at a much broader base or a much broader base.

The next element I want to talk about is management oversight. Management oversight is a feedback mechanism used to let management know whether the processes, the policies, the procedures, the systems are operating the way they intend them to operate. So it is a very important aspect.

Managers visited the facility often. If they did see something that they felt was unsafe, they would bring it to the attention of the workers. But these walk-throughs were not intended to be specific targeted reviews of aspects of the process that was taking place out there. And so they weren't really verifying the efficacy of procedures or how well things were going.

They had a broad measure that they were using to sort of gauge whether things were going well or not, and that was basically the ability of the facility to meet its production goals. And the facility was doing that.

And so as they went out and walked through the facility, when they did see things that were of concern to them and addressed them, but they really didn't go look at the details of the process. As a consequence, there was no one that we had talked to in the management that had ever observed the Booster Room 2 start-up process, to see that they were putting PETN into a vessel, turning on the heat, turning on the mixer, without adding TNT. They weren't there, they didn't see it.

Line managers and supervisors had extensive experience, but they may not have had a depth of experience needed to walk through the facilities and see some of the practices as being hazardous practices. An example of that is the breaking up of the boosters that might have related to and some of the other processes. Management was aware of many of those processes but didn't see those as being unsafe conditions.

Although Sierra Chemical used standards in developing the design that they were doing, the primary technical basis for operations, as I said, was their experience. Management had no planned program for oversight to determine that safety management programs were effectively implemented and safe work practices were followed. When supervisors and managers did do those walk-throughs, they did not verify the knowledge and performance of the workers against any documented standards.

While it's not certain that they would have recognized all the unsafe practices, many of the potential familiar modes of this accident could have been eliminated by evaluating worker performance against industry and regulatory safety standards.

The booster process did not adequately manage, have adequate management controls to ensure the work would be done safely.

As we have said, in other locations, this lack of management oversight and the failure of the feedback system to give them the information they needed is a contributing factor to the accident on January 7th.

Next element I have is pay policies, and I'm only going to go very briefly into this. There were three basic pay processes used for the workers out at the facility. There were professionals, there were salaried supervisors.

The outside workers were paid by the hour. The piece rate and piece rates, the pieceworkers, which would be the melt pour operators -- I'm sorry -- the melt pour operators would be paid by the piece.

We initially had concerns about how that would affect the operation, and whether or not they were being pushed to produce higher and in order to make levels of pay that were similar. And one of the things that we did is look at other industries, other industry manufacturers, and determined that the quantity and the hourly rate made out at the Kean Canyon facility is in line with the other facilities. So there isn't an undue emphasis on salary or production in those terms.

However, there are some byproducts of having an incentive process that we felt may create some concerns. One of those has to do with the training process, as you recall, on-the-job job process using a senior operator training a junior operator.

The senior operator is being paid by the number of pieces that he produces in a day. So while he's doing training, he's not as efficient as he would be otherwise. That's an incentive for him to ensure that the worker that he has training gets the information quickly and moves on so that it doesn't cost him too much to train that individual to do the job.

CHAIRMAN HILL: So you are saying it is actually a disincentive for that employee to spend a lot of time training a new employee to come on line.

MR. WALTERS: That is right. So there is a potential byproduct here that has the wrong incentive.

On the other side of it, in some cases what the pay policy has done is it put a lot of ownership for doing the work with the workers, and they were given a lot of latitude in developing how they were going to do that, which also adds the latitude issue we have already talked about is a problem.

The last element that I have to cover is documentation. The programs, there were procedures, there were safety orientation and training, there were incident and investigation procedures. They had emergency response procedures, they had maintenance documentation. They had many forms of documentation.

But again, all of those documents that they had were written in English. So most of the workers were unable to read and comprehend what was in those documents. So the purpose of the documentation, at least on the workers, from the workers' perspective, was not adequate.

Workers at the site did not use and were not aware of most of the programs and documentation that Sierra Chemical had to demonstrate that they put together programs. However -- as well they were not aware of the specific hazards associated with the materials except that there were explosives and they were required to wear dust masks. Information had been communicated orally because the material safety data sheets that had chemical hazard information on them were not available to them in their language.

The workers were not aware of these written procedures and that they had even existed, and they obviously weren't used. We believe that this lack of documentation which would have helped the workers understand the hazards and would have provided more control over the processes was a contributor to the accident on January 7th.

Mr. Chairman, thank you for giving me the time to present this information. That completes my section.

CHAIRMAN HILL: Okay. Thank you, Dennis.

I'd like to ask just very quickly if there are any questions, clarifications from any of the tables present, anything you heard that you would like to ask to be clarified or to raise as an issue for our consideration.

GENERAL CLARK: No, Mr. Chairman.

MR. SWIRCZEK: Mr. Chairman, Ron Swirczek, Nevada Division of Industrial Relations. As we indicated at the beginning of this inquiry, we will not be commenting at this time, but in this particular area, yes, we will have comments for the Chemical Safety Board.

CHAIRMAN HILL: We'll certainly look forward to receiving those, Ron, again in the next 30 days if at all possible.

John.

MR. PIATT: The next section I would like to cover is on regulatory oversight. Various state and federal agencies have responsibilities for regulatory oversight of explosive operations such as Sierra Chemical's. For example, Truckee Meadows Fire Protection District inspects facilities in its jurisdiction for compliance with Nevada State Fire Marshal's regulations under the Nevada Administrative Code.

Those regulations establish the Uniform Fire Code as the minimum standard statewide. Uniform Fire Code contains explosive safety requirements in Article 77, Explosives, and Section 7704 of that standard, Manufacturing, Assembling and Testing.

Getting ahead of myself. That's correct.

The Nevada State Fire Marshal's regulations also incorporate by reference the National Fire Protection Association standards, including NFPA 495, code for manufacture, transportation, storage, and use of explosive materials. The NFPA code applies to the extent that requirements are not covered under the Uniform Fire

Code.

The Truckee Meadows Fire Protection District has the authority to require a business to hire a mutually acceptable consultant to conduct a fire safety evaluation of explosives or other hazardous operations. No fire inspectors were trained or qualified to do an explosive safety evaluation, so the inspections tended to focus on fire prevention and life safety issues. Most recent inspection of the Kean Canyon facility was conducted in 1992 and contained only minor violations.

A joint inspection with the Washoe County Building Department of the Kean Canyon facility was planned tentative for January 9th, 1998, in response to the building department's preliminary boiler inspection.

The Department of Motor Vehicles and Public Safety Division of Professional Service Office of the State Fire Marshal, this is the Fire Marshal's responsibility, to inspect and permit hazardous material facilities. Reporting of the maximum quantities of hazardous materials on site during the past year is required as part of the hazardous materials permit renewal process.

No inspection of the Kean Canyon facility was found, but a hazardous materials permit of the site had been issued. There is one hazardous materials specialist on the Fire Marshal's staff, but this individual had no explosive safety training or experience. This office also had no -- had oversight of those portions of the state not under the jurisdiction of the local fire protection district for the Uniform Fire Code and NSDA compliance. So essentially the State Fire Marshal's office covered all those jurisdictions not under a local fire protection district.

The Occupational Safety and Health enforcement section has responsibility for compliance with general industry safety and health standards adopted from the Federal Occupational Safety and Health Administration. These standards include requirements for safe storage of explosives and process safety management of explosives manufacturing operations.

There is no requirement that documentation of hazards and safety management systems required by process safety management standard be made publicly available. The most recent inspection by this office of the facility was conducted in 1996. It was predominantly an industrial hygiene evaluation of practices used to control the lead exposures in the flux mixing operation.

Booster Room 1, which was the only explosive process in operation at the time, or in existence at that time, since the Booster Room 2 had not been built, or the equipment in that room had not been installed, was the only thing that was in existence. And that inspection by OSHA did not cover that because it was not in operation at the time that they conducted their inspection.

The Reno Occupational Safety and Health enforcement section office has some familiarity with explosive operations but little formal training in explosive safety. This office has the ability to request assistance from the federal OSHA inspectors who might have more explosives expertise, but such expertise may not be readily available for routine inspections.

In response to the Pepcon explosion May 4th, 1988, the State of Nevada and the Divison of

Environmental Protection of the Department of Conservation and Natural Resources adopted a chemical accident prevention program which was based on the draft federal OSHA rule for process safety management of highly hazardous chemicals. Unlike the federal OSHA statute, the state standard was not expanded to cover the manufacture of explosives.

Subsequent to that, EPA has enacted a risk management program standard. In that standard, which the draft standard did include explosives, but subsequent to that listing and coming out with the final standard, explosives were delisted as a hazardous material.

Explosives then are excluded from the list of hazardous materials in the federal EPA risk management program.

The Bureau of Alcohol, Tobacco and Firearms licensed the Kean Canyon plant to manufacture and import explosives. The BATF inspects licensed facilities to insure the safe and secure storage of explosives, to insure that explosives are properly inventoried and controlled, and to insure that all records are kept accurately. The last BATF inspection of the Kean Canyon plant was conducted in 1995. Although the BATF licenses manufacturers of explosives, it does not inspect the manufacturing process.

The Washoe County Building Department is responsible for reviewing new construction. Sierra Chemical Company had applied for a permit for the new steam boiler. Booster Room 2 involved modifying an existing building, so no additional building permit was sought.

Preliminary inspection of the new boiler was conducted in September by the Building Department. As a result of this initial inspection, contact was made with Truckee Meadows Fire Protection District to plan a joint inspection. This explosion occurred before that inspection date arrived.

The principal agencies then responsible for safety of explosives manufacturing operations of the Kean Canyon plant were the Occupational Safety and Health enforcement section and the Truckee Meadows Fire Protection District.

The experience and training of the responsible agency staff required to conduct comprehensive inspections of explosive manufacturing facilities is limited. Truckee Meadows Fire Protection District planned a joint inspection with the Washoe County Building Department, and this is a good example of how communication can improve oversight. However, it was initiated by the Building Department as a result of a preliminary boiler inspection rather than as an established requirement by the key agencies for inspection of new or modified explosives facilities prior to operation.

Following the Pepcon explosion near Henderson, Nevada, the Governor's Blue Ribbon Commission looked into the adequacy of regulations pertaining to the manufacture and storage of highly combustible materials. The commission's report stated in part, and I quote:

"The Commission feels it is imperative that high hazard businesses be inspected no less than four times a year and more frequently if necessary. All hazardous industries require at least one rigorous annual inspection."

The identification and prioritization of inspections for high hazard businesses has not been done to accomplish this recommendation.

The second recommendation of the Commission's report was that businesses, and I quote:

"should be required to provide local governments with a detailed analysis of what dangers exist and how they intend to mitigate them."

Simply providing a list of the hazardous materials on site falls short of fulfilling this recommendation. Nevada's planned adoption of EPA's risk management program, which does not include explosives, if not amended, will exclude coverage of explosives as hazardous materials.

The next section that we would like to cover is a brief overview of the analytical techniques that were used just to give you a sense of the nature of the analysis and the benefit of having done that. I'd like to start this by talking first about a barrier analysis to give you an idea of some of the types of things we look for in terms of the types of controls.

A barrier analysis is used to identify administrative, management and fiscal barriers that could prevent, control or reduce energy flows to targets such as people or objects. This barrier analysis was concerned with those barriers that could have prevented or mitigated the impact of explosions, but either failed or were not present.

This slide shows a summary of those types of barriers. You will notice at the bottom is the energy source, the detonation of explosive, and at the top is the target, which could be considered workers or even facilities.

Looking at some of the physical barriers that you might expect to be present, starting from the bottom and working up, the facility design to prevent secondary explosions. The design of the PETN building, for example, with a skylight built into it provided at least a weak point which could provide access to impact of falling debris from an explosion elsewhere in the site.

Explosive quantity distance separation of facilities. With the amount of explosives in the three rooms, these separations were not met, and that may be a consequence of the increased explosive loading due to the addition of this facility and kind of expansion of operations. But it should not have been allowed to exceed acceptable quantity distance limits.

Looking at management barriers, we have just talked about a lot of those, including the direct supervision, management oversight, and even some of the industry and regulatory oversights. Looking at the administrative barriers above that, things such as process hazard analysis, procedures, management of change, training, would be the types of things that were considered there. All of these have a role in preventing first an energy flow from hazardous operations to impact workers or facilities.

The next thing that we'd like to talk about is change analysis, and Dennis will come back and talk briefly on an overview of change analysis that was conducted, and its purpose.

MR. WALTERS: Thank you. Mr. Chairman, the change analysis is one of the tools that is used to help identify the causes of accidents. In a change analysis, there is one question to be considered, what is different about the operation on the day of the accident, so that you can understand how that accident occurred.

If Sierra Chemical Company manufactured boosters for more than 20 years without an incident, what changed to permit an explosion to occur in the new part of the facility.

In the initial steps of the change analysis, the team developed several hypothesis of types of changes that would account for these kinds of things and then would go through a process to see whether those changes were in place. And also during interviews and in bringing information back and analyzing it, the team also looked for those changes that would account for how this could happen now and it hadn't happened for 20 years of operation.

There is a detailed summary of the change analysis as it relates to each of the four scenarios that the investigation team considers to be potential causes of this, direct causes of the accident, and so I'm not going to go into that in detail. Most of the information that has been discussed today is incorporated in a change analysis table back in Appendix B.

Differences that are not considered to be applicable to the accident have been omitted from that table. So as we went through a process step and said this change did not cause the accident, we eliminated it from the table. So otherwise the table would be much longer than it is. Thank you.

CHAIRMAN HILL: Okay. For those of you present, as these references are made by Dennis just now to Appendix B, that is indeed part of the draft report that this group is now preparing for the Board and will be contained and provided in the public documents as they are completed and released. So you will have access to that information as it is completed.

MR. FAILEY: Mr. Chairman, as part of this accident investigation, we conducted an analysis of potential ignition sources. Potential ignition sources were evaluated based upon the physical evidence that was obtained, analysis of changes, testimony, and historical information. The relative likelihood of each initiation source was judged on a qualitative basis, on factors that either supported or reduced the likelihood of the event initiation by this factor.

We have included in our report a table that contains the results of the team's analysis, and that's listed under the Appendix A. Just as a summary of the ignition sources that we actually looked at, we looked at the possibility of this accident occurring due to electrical equipment arcing or sparking, static electricity, mechanical sparks caused by males when a pallet is dragged across concrete, ferrous metal objects impacting, impacts generating a potential spark, friction when dried PETN is dry blended without having TNT present, friction when a pallet slides over explosives that are left on the floor.

We looked at ignition sources that included forklift strikes to pallets of staged explosives, the striking of explosives with metal tools, mixing blade impacts on hardened explosive left in the kettle, tool or pot components dropped into the pot, foreign objects in the explosives struck by the mixing blade, the possibility of a fuse element present in the demiled high explosive.

And what we mean by that is the potential that perhaps one of the actual fusing mechanisms from a demiled round was included in the reclaimed material. We looked at open flame due to lighters or smoking in the area. We looked at the possibility of chemical reaction between different explosive types.

We also looked at ignition sources where cross-contamination occurred between incompatible processes. And specifically what we're talking about there is the transfer of incompatible chemicals from the flux operations into the operations of the explosives due to the close proximity of the two operations.

We looked at ignition sources from mechanical failure of bearings on the drive motors, of propane leak and fire, possible steam boiler explosion, and just very briefly sabotage as well.

Just an example of how we went through this analysis, I'll take a look at mixing blade impacts with hardened explosives left in the kettle. We would list supporting factors for that possibility.

And in the case of the mixing blade impacting hardened explosive, we came up with supporting factors that included if the residual solid base mixer pentalite remained in the pot, and the melt pot mixing blade was engaged, the impact forces on the explosives could ignite a large quantity of base material or pentalite.

Also reportedly about 50 to a hundred pounds of the base mix had been left in the pot, as we have discussed, the preceding night. The crossover of personnel and melting techniques from the evening shift to the day shift increased the chance of not taking the proper sequence of steps to ensure the melt had formed before engaging the mixing blades.

Because the operator in Booster Room 2 had previously worked on a swing shift in Booster Room 1, he never had to inspect the pot there before turning on the mixer. An inspection of the pot was not needed because the heat would have been left on and the material still melted from the previous shift.

Because the two operators in Booster Room 2 had talked about the leftover base mix, the operator who left it may have assumed the other operator had used it.

These were supporting factors for that possible ignition source.

Factors that reduced that likelihood in this case was that testimony suggested that the pots should be inspected at the beginning of a shift to ensure that no solid material was present in the pot. No startup checklist existed, however, and a record to ensure that the inspection occurred was not maintained.

Based upon the supporting factors and the factors that reduce the likelihood, the possibility of ignition from the mixing blade impact on hardened explosive we deemed high. We rated all the other ignition sources in a similar qualitative fashion listing them as low, moderate, improbable or high.

And again, these details of these ignition sources appear in the Appendix A.

CHAIRMAN HILL: Did you have any people come forward, while of course you were working here in the area, working with various organizations and agencies, at the time did anyone offer particular scenarios that they thought may be ignition sources that then you were able to pursue and either determine were inappropriate or were very good leads for what you did?

MR. FAILEY: I would say that the interviews, the information that was provided on the interviews gave us the direction to begin to look for possible causes, which included some testimony that indicated that static electricity, for example, was a problem in Booster Room 2. Part of the testimony we received was that at times static discharge in that room was similar to walking across the carpets in a casino and then touching a metal object.

So certainly the testimony from the workers provided a great deal of direction as to what to pursue and what to dismiss.

CHAIRMAN HILL: In particular, I'm recalling with our sister agency, the NTSB, that many individuals step forward and simply provide information to the investigators regarding what they feel may have caused them. If you are familiar with TWA flight 800, people suggested that it may have been a surface to air missile, or a variety of other particular scenarios which brought down the plane and caused the tragedy, but were able for the agency at least to have that as consideration for whether there was any evidence to support that, and that was the reason for my question.

MR. WALTERS: One thing I would like to respond on that, Mr. Chairman, is that in each of the interviews that were conducted with workers, with members of the supervision and management of Sierra Chemical, one question was always asked. In your opinion, what do you think the possible causes could have been for ignition of this source?

There was, for a great deal of the time, there was confusion. We believe that we have resolved that in our analysis as to which building went first. If one were to consider that the PETN building went first, then the scenarios that could cause that to happen are pretty much restricted to an act of sabotage.

But the table that we have used is based on our conclusion that the initiating event did not occur in PETN building, and so we would also ask those people a hypothetical question, well, even though you think it happened in the PETN building, if perhaps it did happen in Booster Room 2, what do you think could have caused that?

So many of the -- we did generate more ideas from the work force by soliciting that question.

CHAIRMAN HILL: Okay. That's good. Thank you, Mike.

Okay. John, where do we stand here? You have a couple of additional items to cover?

MR. PIATT: We are at the home stretch.

CHAIRMAN HILL: Would the group like to take a 10-minute stretch here? Maybe a restroom break and come back at five minutes after three, and we will do the final wrapup and perhaps finish a little earlier today than we had anticipated, but that also will be detailed by any comments that also would be solicited at the end. So we'll come back in 10 minutes.

(Recess taken at 2:58 p.m.)

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RENO, NEVADA, THURSDAY, APRIL 16, 1998, 3:10 P.M.

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CHAIRMAN HILL: I'd like to go ahead and reconvene. If we could get the investigators back in the room here. Thank you for returning.

I'd like to reconvene now and ask Mr. John Piatt to continue. I think you had left, John, a couple of items here. Tentative conclusions and judgments of need were a couple things I jotted down earlier you mentioned. Please proceed with your comments.

MR. PIATT: Thank you, Mr. Chairman. Based on the information currently available, we'd like to summarize the team's tentative assessment of the contributing factors, preliminary conclusions and judgments of need. This will kind of bring you full sweep through the accident investigation process where we started with the facts, gone through analysis, looked at variety of control issues to control potential for explosion, and now we're coming kind of full circle back to looking at what do we think are the principal contributing causes, what are the tentative conclusions, and what are the judgments of need.

It is impossible to know with certainty the immediate cause of the explosion. However, the investigative team identified four incident scenarios that could have caused the explosion in Booster Room 2. These scenarios take into account the time available at the time of the accident since it was just a startup of the operations in Booster Room 2, and the activities that would normally occur during this time.

Based on the analysis of ignition sources that Mike Failey presented and the change analysis that Dennis presented, one of these scenarios is considered more probable than the other three.

The team believes that the probable immediate cause of the explosion was that the Booster Room 2 operator turned on the mixing motor to pot 5 containing 50 to a hundred pounds of solidified explosive base mix. The start of torque on the mixing blade resulted in impact, shearing and friction of the explosives and the resulting detonation.

A metal graphic analysis of the hub in pot 5, of a pot 5 mixing blade concluded that the damage to it was consistent with shock loading from contact with high explosives upon detonation. This is basically just the hub at the bottom of the mixing shaft. All this does is confirm that explosives were present in pot 5 at the time of the explosion.

There were three other scenarios that were considered less likely. And I'd like to describe those three scenarios.

The first is that foreign materials or hard lumps of the composition B or substitute materials that were added to the base mix pot 5 caused a detonation due to impact, friction or shearing. The risk of an explosion might have been increased by the presence of partially melted residual explosives from the previous day.

The third potential scenario is that electrostatic discharge or friction detonated PETN that had been added to the pentalite pot 4 and allowed the heat-up without any TNT in the pot to dissolve the PETN and act as a lubricant. Because the PETN does not melt by itself but instead dissolves in TNT, placing the PETN into the heated mixing pot increased the risk of detonation due to friction or possible static generation in the mix.

The fourth potential cause is the breakup of lumps of comp B or harder or more sensitive substitute materials with a steel hammer causing a detonation outside the mixing pot due to impact or impingement of explosives between a hammer and either a foreign object in the material or another hard surface. The use of steel hammers to break up explosives was reported by workers.

And a recent change was the use of LX-14, one of these composition B substitute materials that had harder and larger lumps that were possibly harder to break up. The use of additional force to break up these lumps and the potential presence of foreign materials in the lumps could have resulted in a detonation.

There are a variety of contributing factors at organizational levels that may have contributed to this explosion.

The systemic causes tend to fall higher organizationally, and when addressed, tend to have greater impact on the safety of the operations.

The principal underlying causes of this

incident that I'd like to discuss, and there are four of them, include the following: First, the knowledge base of the organization was insufficient to assure the safety of operations at the facility; second, program elements for process safety management were not effectively considered or implemented at the facility; third, management oversight of explosive operations was not sufficient to ensure that safety management systems were effective and that safe work practices were followed; last, responsible regulatory organizations did not have the necessary safety expertise for explosive operations and did not identify and prioritize inspections of hazardous facilities to provide a level of oversight commensurate with the risks involved.

So at this point I would like to talk briefly about the conclusions and judgments of need, and I'd like to review those scenarios and briefly summarize those. Scenario 1, mixture blade impacted solidified explosives that had been left in pot 5 in Booster Room 2 the previous day.

Scenario 2, foreign materials or hard lumps in the composition B or substitute materials that were added to the base mix in pot 5 caused a detonation due to impact, friction or shearing.

3, electrostatic discharge or friction

detonated the PETN that had been added to the pentalite pot 4 and allowed to heat up without any TNT in the pot to dissolve the PETN and act as a lubricant.

And 4, the breaking of lumps of comp B or harder or more sensitive substitute materials with a steel hammer caused a detonation outside the mixing pot due to impact or impingement of explosives between the hammer and either a foreign object in the material or another hard surface.

The following tentative conclusions summarize the significant facts and analytical results of this investigation. The judgments of needs contain measures that the team believes are necessary to prevent similar incidents in the future in the explosives industry or to mitigate the consequences of such events. These judgments of need flow from the tentative conclusions and the contributing factors. They are intended to serve as a guide for developing follow-up actions in the final report.

Because safety management systems are similar throughout the explosives industry, it is hoped the consideration of lessons learned in this event will be beneficial as a self-assessment tool for a wide audience.

Our first conclusion is that there was

limited technical knowledge of explosive safety. Safety decisions were based primarily on experience at this facility.

In looking at the judgment of needs arising from this conclusion, we believe that there is a need for industry, Department of Defense, unions, governmental oversight organizations, to come together to develop a certification program for explosive manufacturers and explosive workers. This program should include a guide to explosive hazards and safe operating practices, guidance for design of explosive manufacturing facilities and equipment, criteria for knowledge and experience needed to safely manufacture explosives, and processes for certifying and recertifying people involved in manufacturing explosives.

Second, there is a need for industry and Department of Defense to share incident, near miss and other explosive manufacturing lessons learned information.

Third, there is a need for information about this incident and follow-up actions to be communicated in an industry forum.

Our second conclusion is that the process safety management elements had not been effectively developed and implemented at this facility. The judgment of need resulting from this conclusion is that manufacturers of explosives need to review their process safety management programs to insure the protection of workers and the public.

Special emphasis should be given to the following elements. The PHA must systematically address all relevant hazards and consider siting issues, including quantity and distance of unrelated operations. It should consider facility design, human factors that might contribute to accidents, and industry experience and practices.

Procedures have to be specific to the

process being controlled and address all phases of the operation. Workers must be trained and skilled in using those procedures. The procedures have to be written and communicated in the language understood by the worker to ensure that the procedures will be followed.

Workers have to understand the hazards and controls associated with explosives manufacturing processes. Training criteria have to be documented and an understanding demonstrated. Changes in explosive ingredients, technology, process changes, equipment and procedures must be evaluated before being implemented.

Our next conclusion is that internal oversight processes did not detect potentially hazardous work practices at the facility. The judgment of needs from this include the following. The explosive industry needs to review hazardous processes and activities on a regular basis through self-assessment and independent oversight to ensure that safety policies and procedures meet expectations and objectives. And on-site supervision is needed during all explosive handling and manufacturing operations.

The next conclusion is that the frequency and depth of inspections by oversight organizations responsible for explosive manufacturing operations were not commensurate with the associated risks. State and federal oversight organizations in looking at the judgment of needs must improve the effectiveness of oversight activities at high risk sites to the following activities. First, they must identify high risk sites and operations, prioritize their inspections according to risk, coordinate and clarify roles between agencies to minimize overlaps or omissions, conduct self-assessments to determine ways to improve effectiveness, such as the Governor's commission is doing right now, and ensure that necessary expertise is available to evaluate special process hazards.

Our next conclusion is that reclaimed high explosive materials sold by the Department of Defense in an as-is condition creates a potential hazard because of product consistency and the presence of foreign materials. The Department of Defense should either insure the recycled explosives have a uniform consistency free of hazardous foreign materials, or alternatively, require that buyers who use such materials in a manufacturing process certify that they have the equipment and procedures to eliminate such hazards.

The final conclusion that we have is that co-located chemical operations unrelated to explosive manufacturing processes resulted in the death of a chemical worker and created potential environmental hazards as a result of the explosion. The judgment of needs associated with this is that there is a need to use quantity distance tables and requirements for their application as a siting criteria to unrelated chemical processes and storage facilities at explosive manufacturing sites.

That concludes our presentation, Mr. Chairman.

CHAIRMAN HILL: Thank you, John, and thanks to the other investigators on the team.

I just have a few general questions of you that I hope might be clarifications. Do you feel that you have, up to this point, pursued all of the viable reasonable scenarios that could possibly have caused this incident to occur?

MR. PIATT: I do.

CHAIRMAN HILL: That is the answer I was looking for. Thank you.

One of the other questions was relative to the coordination, and you mentioned something about the fact that there were various agencies with various authorities, and even the Governor's commission is looking at that within the State of Nevada. But my question deals more with the issue of the coordination at the site during the event.

Was there any problems with your ability to conduct your work, particularly chain of custody issues, that sort of thing, that occurred that you would recommend to this Board in future investigations that we consider, and have you placed any of that information in your report?

MR. PIATT: We have not included any of that information in our report. I would say that in this accident and in this location, we were indeed blessed with more cooperation than we could have ever anticipated from all the agencies that were involved, from some of the agencies that were not directly involved but wanted to provide support, looking at the federal OSHA people from California who brought over trailers as a command post when the Washoe County Sheriff's Office completed their investigation and withdrew their command post. So there was a lot of good support.

In terms of some of the things that you see today, we obtained support also from people like Army National Guard who just happened to be doing some other aerial photography types of things and wanted to provide additional support to say, look, we can try to help look for things that look like maybe unusual objects in our aerial photography of the site. We used their aerial photos in order to help locate or help identify distances from the site that some of these parts were thrown from the original locations.

We had an amazing amount of support.

CHAIRMAN HILL: This question is something I jotted down earlier, primarily for Mike. Regarding the chemistry that you went through in some level of detail, do you feel there is a good understanding of what happens strictly from a chemist's point of view, a good understanding of these materials, what happens when they get together in certain quantities under certain conditions such as pockets of different materials forming or solidifying? Do you think that is well understood at this point such that you have complete confidence in how that information that you generated entered into the conclusions that were reached in this group?

MR. FAILEY: I believe looking at the specific energetic components that existed, for example, the RDX, HMX, TNT, that the chemical compatibility issues have been addressed in that the chemistry is understood well enough between the interactions of those pure compounds to say that there wasn't some type of event that led to formation of sensitive byproducts that could have caused this initiation event.

The presence of other foreign materials in the recycled or reclaimed materials and their interactions, however, cannot be fully dismissed either. But it would seem unlikely, it seemed unlikely to us that given that these materials had been handled for months before the operations, that chemical incompatibility issues would not have been a cause here.

I don't think that the chemical compatabilities of possible impurities in the recycled material are known well enough to fully address what sensitive byproducts may form.

The other issue that clearly was a concern for us at the onset of this investigation was looking at the presence of the other chemicals and the possibility that in particular lead oxide could have been introduced with some of these explosive materials, which are believed to be quite incompatible. So there is an understanding of that chemistry, too.

I would only say that the gap is in the impurities that may exist in the recycled reclaimed material.

Perhaps one other issue. Even though the PH of this material had been checked once, that is a potential cause of violent chemical reactions in explosives. If the PH of the material is too basic or too acidic, essentially if it is too basic for TNT, there are no mechanisms for formation of sensitive byproducts that could in a relatively short time form explosive byproducts that could initiate a pot of explosive.

However, again, these operations had been continuing or had been conducted for about 20 years using materials like this. So we didn't deem as if this was a chemical compatibility issue; that that was a high probability.

CHAIRMAN HILL: Okay. That's useful. In fact, that leads into my final question. Probably Dennis dealt with this more during his presentation.

Do you feel that contrary to conventional wisdom that the safe history and the lack of accidents at Sierra Chemical over the past 20 years actually was a contributing factor in that just lack of concern for hazards sometimes breeds familiarity, and therefore, that that, too, was considered contributory to this incident?

MR. WALTERS: Yes, I do. I believe that management at Sierra Chemical felt that their process was adequately protected, and that they were safe enough to prevent this kind of accident from occurring, and I think that came from their experienced years in working in it, working with the materials, and that the element that probably most significantly impacted them was that they didn't have adequate information to the contrary because they didn't have adequate oversight.

CHAIRMAN HILL: And that no doubt was passed on to the employees, the community, the enforcement agencies, and tends to have a ripple effect.

MR. WALTERS: Yes.

CHAIRMAN HILL: Okay. I'd now like to call on the other groups that are with us, particularly General Clark representing the commission and the Governor's office in particular, the State. Do you have anything that you wish to add for the record or issues you wish to raise based on what you have heard here today?

GENERAL CLARK: I would merely add for the record, Mr. Chairman, that immediately after this incident, Governor Miller appointed a commission on work place safety and community protection to investigate this incident, to ensure that federal, state and local government entities work with operators of hazardous and volatile material manufacturing facilities in Nevada to provide a safe working environment for employees of these facilities.

Our commission is reviewing state laws, policies, regulations and inspection regimes of governmental agencies relating to the manufacturing process, to storage and handing of these highly volatile and toxic substances. It is examining emergency response procedures, it is reviewing federal, state and local regulations dealing with design and placement of these facilities.

We have held three meetings of our commission thus far. Our fourth meeting will be next week.

We hope to receive the preliminary report of the Chemical Safety Board as soon as possible so that we can utilize that as the basis of formulating some of our responses and recommendations to the Governor and for our next legislative session. Understand that it will be this summer that the state departments will be putting their budgets together for submission to the legislature, and they will need that information if additional funding is going to be necessary for experts, additional investigators, training, and things of that nature that have already been identified today in the testimony by Mr. Piatt and his associates. And we're also looking forward to receiving at our next meeting our State Division of Industrial Relations report on its investigation and its findings.

Shortly thereafter, we will start to draft our findings and recommendations for the Governor and for our legislature. But at this point, it's a little too preliminary for our commission to make any specific recommendations.

And we thank you for the opportunity to be here today to learn from your investigators and all of the great investigative work that they have done.

CHAIRMAN HILL: Thank you. Certainly we recognize the State of Nevada for the work you have done in the past in this area and continue to do under the Governor's direction as the decision was made to put together this commission to look at issues particular to the state. It fits very well with the mission of the Chemical Safety Board into making recommendations for the entire nation dealing with such matters.

And certainly I would recommend to any of you the things that you heard here today. This is an intent of the agency to try to provide you an independent view coming from the outside, not knowing all the details within a state, but simply looking at detail at a particular situation and trying to make independent recommendations. It's not an attempt to be critical of anybody's performance. In fact, we certainly again commend the State of Nevada for your leadership that you have provided in the past and continue to do so.

I'd now like to call on Captain Barnes, if you have any additional comments you'd like to make on behalf of the emergency response organizations or anybody else at the table, again for the record, anything that you may have heard or not heard today that you think needs clarification.

MR. BARNES: I only have two comments to make. One is I'd like to second the comments by General Clark about the quality of the investigation by the Chemical Safety Board. It's a very impressive piece of work investigation and research and analysis, and my compliments to all of you and your staff.

And secondly, with regards to a comment that was made in response to one of your questions on the cooperation they received. As the Chemical Safety Board was preparing to leave Reno after their first visit, I mentioned to one of the Board members, and I want to mention it again now, that I think success of future investigations like this, especially when you have a multijurisdictional investigation and issues, is the success of the instant command system and the concept of a unified command. I would encourage the Chemical Safety Board to use that system and that method of organization on future investigations in other jurisdictions they go to where you have a multijurisdictional issues and efforts. That's it.

CHAIRMAN HILL: Thank you. Certainly appreciate your remarks and your support throughout this process.

Ron Swirczek, I'd now like to call on you also with the same questions in mind. I realize you have some pending issues with your own investigation and potential enforcement actions that your agency may choose to take, and I realize that hinders your comments today because of that, but again, anything generally you'd like to bring out at this time, please feel free to do so.

MR. SWIRCZEK: Mr. Chairman, for the record, Ron Swirczek, administrator of the Nevada Division of Industrial Relations.

I also as the administrator of the division would like to comment and extend a compliment to the

Chemical Safety Board. You asked the question about cooperation. We found that although our objectives overlapped somewhat, the overlying, or the overlap was how do we prevent or learn from this tragedy to prevent this type of situation from occurring in the future.

I would extend that, and I have talked to you about this before, I have never worked with a finer bunch of group of people. John, Mike, Dennis, and the other investigators came to this tragedy and in a no nonsense professional approach. Professional courtesies were extended both ways, and we both went to work sharing and exchanging information where appropriate, and there were some areas where it wasn't appropriate and we clearly understood each other's bounds.

With that, we look forward to next week being able to sit down with you, with our written findings and recommendations. We believe that those will add to the recommendations that you already have gotten on record.

We will go before the Governor's commission with our findings and recommendations, and those recommendations will come to you through that particular commission, or we will be, as I said, hopefully sitting down with you to speak openly directly about our findings and recommendations.

CHAIRMAN HILL: Thank you, Ron. We certainly look forward to remaining in touch with all of these organizations as we move forward in both your work and ours to conclude our work.

As we started today, I indicated that this was a step in the process and that we would be receiving additional comments for another 30 days as well and preparing a final report that will include the Chemical Safety Board's recommendations.

We have the investigators's primary recommendations now presented on the public record. They will be considered in further detail by the full Board itself. And at that time we will issue final recommendations which we will then pursue working with other agencies along the line of what John suggested as to how we go about making sure people are aware of those, how they might be implemented, and where we can find various audiences to get the word out about what we have learned from this particular tragedy.

John, anything further?

(No response.)

CHAIRMAN HILL: If not, I will provide some closing remarks.

With these statements having been made by the investigators, and as there are no further comments from the invited organizations, this phase of the Chemical Safety Board's investigation into Sierra Chemical Company Kean Canyon plant is now concluded.

In closing, I want to express my deep appreciation to all those who participated today in this Board of Inquiry. As I said when we began this morning, open CSB inquiries such as this are an exercise in accountability.

In holding them, we seek to explain to those people who are most directly affected, employees and their families, the company, the local community, and also to the American public, where we are at in an investigation, and describe in some detail what has been done to date, not only by the Safety Board, but also by the local response organizations, industry and the federal and state regulatory authorities.

We have presented all of the factual information available at this time. I hope that we have been successful in demonstrating the breadth and depth of this effort to determine exactly what happened at Sierra Chemical Company on January 7th, 1998, that resulted in the tragic loss of lives of four individuals. We have to take a careful objective look at all conceivable ideas and theories, and have called on a wide array of experts to assist us in this endeavor.

We are by no means finished. Our work will continue, and we will spare no effort to determine the cause and causes of this explosion. I am confident that in this process we will learn a great deal more that will help to make the explosives industry safer.

It is the Board's goal not to just find out why this particular explosion happened; more importantly, it's how to prevent such explosions from happening in the future, and we have all said that today. Recent history demonstrates that we cannot move too rapidly to accomplish our goal.

Last month, on March 27th, four workers were killed in Yuma, Arizona, at a factory that used explosives to make model rockets. Another five lives were lost in November 1997 at just about the time that our agency was formed, at a toy manufacturing company in Los Angeles, again using explosive materials.

While companies handling explosive materials are currently subject to OSHA's process safety management regulation, they are not subject to EPA's regulation mandating development of risk management plans which also carry the requirement of public disclosure.

The Bureau of Alcohol, Tobacco and Firearms issues licenses to companies that manufacture explosives but does not regulate or inspect the manufacturing process. We intend to find out from the regulatory agencies and the various industries whose members use explosives what is being done to close the gaps and address the problem of recurring incidents. We further intend to assess the entire regulatory framework prior to making any recommendations for addressing accident prevention.

Along the lines of what the Clark Commission is doing here at the state level, we intend to do at the national level.

Let me emphasize that the record of this investigation will remain open for the next 30 days to permit any interested party to submit any new and pertinent information regarding this incident and the issues discussed here today. This information may include proposed findings of fact, conclusions and recommendations.

And any such information should be sent to the Chemical Safety and Hazard Investigation Board at 1201 Pennsylvania Avenue, Suite 300, Washington D.C., 20004. Submissions should be addressed to Mr. John Piatt. I want to make sure that he gets them for consideration as he prepares to again present this information for the Board's final consideration.

That information should be received no later than May 15th, exactly 30 days from today. And all of this information developed from the Board of Inquiry and any additional information that is submitted will be carefully considered by the Board during its final preparation of a final report on the Sierra Chemical incident.

Based on the available information, the Safety Board will determine the probable cause of this incident, and make any safety recommendations to prevent similar incidents. Although the final report may not be released for several weeks, safety recommendations may be made at any time.

And we do not rule out that we would not move forward on those even sooner than the final report.

The record of the investigation, including the transcript of this session and all exhibits entered into the record and any information the Board receives in the next 30 days will become part of the public docket of the investigation and available for inspection at the Board's offices in Washington.

Anyone wanting to purchase a copy of today's transcript, including the organizations participating in the Board of Inquiry, may contact the court reporter who is with us here today at Sierra Nevada Reporters directly, and he may provide you with a copy of the entire proceedings here today.

Even after the 30 days have elapsed and we have released our report on the incident, the Chemical Safety Board may, at its discretion and in accordance with its procedures, reopen the inquiry to make any part of the record additional information that subsequently is received. If something significant surfaces, that doesn't rule out that we would not consider it. We would indeed.

The Safety Board always will welcome any information or recommendations regarding this incident that may assist us in our efforts to ensure the safety of operations that use explosives or hazardous chemicals in any way.

On behalf of the Chemical Safety Board, Chemical Safety and Hazard Investigation Board and the investigation team, I again want to thank the groups, persons, companies, industry associations, and federal, state and local agencies represented here, and all other participating individuals and organizations for their cooperation for this proceeding and throughout the entire investigation incident.

In addition, I want to acknowledge the interest shown by Governor Miller and Senator Reid and the support provided by their offices in ensuring that we could move forward, and thank both of these in expressing their personal interest.

I want to thank the family members and friends who have been with us here today. I know this has been a very difficult time for you. I hope, though, that you may find some comfort in having seen the work underway to determine what caused this explosion on January 7th, and in knowing that everyone here is dedicated to learning how to prevent such tragedies in the future.

We will stay in touch with you as the investigation proceeds. Please contact me directly if the Safety Board can be of any further help or assistance to you in any way.

I now declare this Board of Inquiry to be recessed indefinitely, and thank you very much for coming.

(Hearing adjourned at 3:51 p.m.)

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STATE OF NEVADA,)
) ss.
COUNTY OF WASHOE.)

I, ERIC V. NELSON, Certified Shorthand Reporter and a notary public in and for the County of Washoe, State of Nevada, do hereby certify:

That I was present at the public meeting of the Chemical Safety and Hazard Investigation Board on Thursday, April 16, 1998, and thereafter took stenotype notes of the proceedings, and thereafter transcribed the same into typewriting as herein appears;

That the foregoing transcript is a full, true and correct transcription of my stenotype notes of said proceedings.

Dated at Reno, Nevada, this 21st day of April, 1998.

____

ERIC V. NELSON, CCR #57