U.S. CHEMICAL SAFETY BOARD

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NDK CRYSTAL

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PUBLIC MEETING

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THURSDAY,
NOVEMBER 14, 2013

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U.S. CHEMICAL SAFETY BOARD MEMBERS PRESENT:
RAFAEL MOURE-ERASO, Ph.D., Chairperson, U.S. Chemical Safety Board
MARK GRIFFON, Member, U.S. Chemical Safety Board
BETH J. ROSENBERG, Sc.D., M.P.H., Member, U.S. Chemical Safety Board

STAFF PRESENT:

DANIEL M. HOROWITZ, Ph.D., Managing Director
RICHARD C. LOEB, General Counsel
HILLARY COHEN, Communications Manager

AMY McCORMICK, Contracting Officer
SANDY GILMOUR, Communications Staff
JOHNNIE A. BANKS, CFEI, Team Lead, Washington, DC, Office of Investigations
LUCY SCIALLO-TYLER, Investigator

This transcript produced from audio provided by the U.S. Chemical Safety Board.

P R O C E E D I N G S

(10:30 a.m.)

CHAIRPERSON MOURE-ERASO: And welcome to all of you to the public meeting of the U.S. Chemical Safety Board, the CSB. I am Rafael Moure-Eraso. I am the chairperson of the board. And with me today are the board members, Dr. Beth Rosenberg and Mr. Mark Griffon.

Also joining us here is the General Council of the CSB, Mr. Richard Loeb that is here to my right, and a number of the CSB staff that are also here whose efforts have facilitated this meeting.

Probably over here is - I will ask Dr. Daniel - Daniel Horowitz to identify himself, our managing director, also Ms. Hillary Cohen for our communications department, and Ms. Amy McCormick that is also here, and also Mr. Sandy Gilmour that is part of our communications staff.

The CBS is an independent non-

regulatory federal agency that investigates major chemical accidents at fixed facilities. The investigations examine all aspects of chemical accidents including physical causes related to equipment failures, and most importantly, the root cause of the system failures that allowed these accidents to occur.

The CSB also makes recommendations on the adequacy of current health and safety and environmental regulations, industrial standards, and safety management systems. Ultimately, we issue safety recommendations which are designed to prevent similar accidents in the future.

The purpose of this public meeting today is for the CSB team to present to the board their final report into the investigation or one of our own ***6:54:15 investigations of the December 7, 2009, and that refers to the pressure vessel rupture at NDK Crystal Industries located in Belvidere,

Illinois, and for the board to vote on the final report and recommendations today.

At this time, please allow me to, since we're a safety agency, to go over the mornings - I'm sorry, to go to the morning's agenda. You probably at the entrance saw a copy of the agenda. It looks like this.

So, first, we're going to hear the opening statements from the chairperson, myself, and from the board members. Then, second, we are going to hear the report, the formal report of the investigation team. That includes the video that we produced on this accident.

Then, we are going to - following the team presentation, we will be - the board will be given an opportunity to ask questions on technical specifics or anything to the board that has presented the report, that the team has presented the report to the board.

Thereafter, we will have a public comment period of matters related to the NDK

investigations, and also, the board will vote on the report and recommendations from the - the recommendations of the staff of NDK. That will be the last part of the report - the last part of the agenda.

This is where, I was saying before, this is where a safety organization, we have to point to useful safety information about this room. Let me indicate to you what are the exits that we have of the room if there were going - something to happen here, there, this is the exit in the back, and there is an emergency exit back here if somebody need it - or two exits, yes. We get very close to this second one here, okay?

I also would like to ask you to please mute your cell phones so that we are - the proceedings are not disturbed. And I'm going to proceed with my opening statement.

On December 7, 2009, a 50-foot tall pressure vessel violently ruptured at the NDK Crystal plant in Belvidere, Illinois. The

violent rupture generated many projectiles.

One such projectile, a seven-foot, 100 pound steel beam, traveled 650 feet in the air, striking and killing Ronald Greenfield, a member of the public who was a truck driver at the nearby Tollway Oasis.

At this time, we want to give thought to the fact that an innocent member of the public, going about his business and taking a break at the Oasis gas station on the tollway was killed. I am invited you to observe a moment of silence in honor of his memory.

[MOMENT OF SILENCE]

CHAIRPERSON MOURE-ERASO: Thank you. Let us remember that people's safety is paramount. That is why we, at the CSB, do what we do.

Under the federal Clean Air Act amendments, which established the Chemical Safety Board, we are required to investigate any chemical accident that causes the death of

a member of the public. The final draft report that we will hear today is the result of a multi-year effort to conduct that investigation.

Today, the CSB investigators will describe all the factors that led to the catastrophic incident, as well as the proposed recommendations for ensuring greater safety in the future. I thank them for their efforts.

This is a small team, and this has been one of many challenging projects that we have been juggling, including, most recently, the explosion of the West Fertilizer in Texas, in West, Texas. That has some similar issues that this NDK investigation.

Here are some of the most important findings of this investigation at NDK: first, you are going to find through the report of the staff that there were specific warnings that were made to the company by its insurer admonishing the company of the danger to the public from a pressure vessel rupture.

You also will find that internal corrosion inspections that were recommended were never performed on the vessel that ruptured, or any of the other vessels, and that the pressure vessels did not meet code requirements that were granted an exemption to function.

But at every level, the risk of a catastrophic vessel failure was overlooked, and public safety literally and figuratively fell through the cracks.

As I drove from the airport yesterday to attend this meeting, I took careful note of the remnants of the NDK facility that is visible for everybody that goes on Route 90 east or west.

I was very much struck by NDK's proximity to the nearby Belvidere Oasis, a rest stop that is frequented by trucks and all kinds of travelers at every day - at every hours of the day and night.

This public meeting is our chance

to understand what happened on the day of this fatal accident, and how to prevent similar events from occurring in the future.

If anyone in the audience wishes to comment publicly after the investigation's presentations, I will ask you to please sign up on the yellow sheet in the check-in area, and I will call your name at the appropriate time. As a matter of fact, the managing director, Dr. Daniel Horowitz, will facilitate the discussion, the public discussion.

I will first call the people - he will first call the people that have signed up, and open the floor to anyone that wishes to speak on the issues related to this investigation. Please note that we will have to limit public comments to three to five minutes each.

And I will like to continue by recognizing my fellow board members if they have an opening statements, so I will ask Dr. Rosenberg if she has an opening statement?

MEMBER ROSENBERG: Thank you. Let me begin by expressing my condolences to the family and friends of Ronald Greenfield. My heart goes out to them and to the employees and owners of NDK who survived this traumatic event.

We, at the CSB, aim to learn from industrial accidents. While the process used at NDK is unique in the U.S., there are recurring themes that this event highlights that are far from unique. Sadly, they are all too common.

First, the practice of citing hazardous facilities near people is a problem. Whether the hazardous facility was intentionally cited near a populated area or a town grew up around it, as in the fertilizer plant in West, Texas, these unsafe facilities should be away from places like homes, school, or in this case, a rest stop on a tollway.

I believe we investigated at least eight incidents where zoning is an issue. We

need to use zoning laws to protect people from hazardous facilities. Smart zoning would have saved this truck driver's life. But zoning doesn't protect the people who work inside the hazardous facilities, which brings me to the second recurring theme, unheeded warnings.

There is often an indication that something is wrong before the big explosion happens, but warnings are ignored. In this case, our excellent investigators found that in 2007, a consultant to the insurance company said that the vessels were unsafe, and the insurance company disavowed covering any damage or injuries resulting from operating these vessels.

Who decided to ignore this warning and gamble with peoples' lives? What incentives or pressures was he under, or she under, to choose to ignore this warning? And further, should you be allowed to operate a facility that an insurance company has deemed too unsafe to cover?

I look forward to hearing the details of the investigation, but I wanted to bring up these issues of citing warnings and using insurance companies as financially interested inspectors, because I think they provide intervention points or levers to prevent such tragedies from occurring. Thank you.

CHAIRPERSON MOURE-ERASO: Thank you, Member Rosenberg. Now, I'll ask Mr. Mark Griffon is he has any statement?

MEMBER GRIFFON: Thank you, Mr. Chairman. I would also like to offer my condolences to the family and friends of Mr. Greenfield. The type of incident that occurred at NDK Crystal, Inc., is one of the primary reasons that the Chemical Safety Board was established. Accidents at high hazard facilities or processes such as the one at NDK not only pose a risk to workers, but also the environment and the community.

This case tragically resulted in

the death of one individual. This incident also resulted in other injuries and extensive damage to nearby businesses where some 40 employees were working. This raises very serious public safety questions.

This is certainly not the first time the CSB has investigated incidents that had off-site consequences. In November of 2006, a powerful explosion at the CAI/Arnel facility in Danvers, Massachusetts, resulted in the damage of scores of homes and businesses.

In October of 2006, there was an incident in the EQ Hazardous Waste Plant in Apex, North Carolina, where an explosion and fire resulted in the evacuation of approximately 16,000 residents. In November of 2009, an explosion at Silver Eagle Refinery in Woods Cross, Utah, damaged nearby homes.

More recently, in March 2011, an incident at Carbide Industries in Louisville, Kentucky, resulted in a confusing order to the

local community to shelter in place. In August 2012, a fire at the Chevron Refinery in Richmond, California, resulted in approximately 15,000 people going to local hospitals.

And finally, as the Chairman mentioned, in April of this year, a huge explosion at the West Fertilizer Facility in West, Texas, killed 15 people, injured hundreds of people, and damaged homes and schools in the nearby community.

All these incidents have one thing in common, they don't stop at the fence line. These incidents impact and involve the entire community. The fix for these types of incidents is not simply a technical fix, better pressure vessels, stronger piping, but rather it's a systems question. What systems are in place to assure there are minimal risks to the communities near these high hazard facilities?

Safe facility citing is the most

important issue, in my opinion, in this NDK case study, but it's certainly not an issue unique to the NDK incident. The West Fertilizer incident made the issue clear to the nation.

I fully expect to see the issue of safe citing studied more comprehensively in the West Fertilizer investigation that are our agency is currently working on.

Finally, I want to say that I'm very glad that we're having a public meeting to discuss the incident of the NDK Crystal site. The work the investigative team put into the report is tremendous, and it's very important that we share our findings and recommendations with the public in a public meeting such as this.

Having said that, I must note that the report comes to us, the board, almost four years after the incident occurred. This is way too long. This lengthy time to complete a case study, which certainly is not the fault

of the investigation team, points to a failure in planning and needs to be addressed.

I've asked numerous times for a comprehensive work plan dealing with the backlog of our investigations, and for public meetings to discuss the status of open investigations, but to no avail.

The board members and stakeholders need to be updated on the status of investigations, the direction of investigations, the priorities, the planned products, and the timelines for completion.

We, as the board, are accountable to the public, and we need to do better and have more timely reports. Thank you.

CHAIRPERSON MOURE-ERASO: Thank you, Mr. Griffon. At this time, I would like to introduce Johnnie Banks and Lucy Tyler, the CSB investigative team that produced this report. Ms. Tyler was not able to travel today being with us, and she's joining us through video in the screen that you can see.

Mr. Banks, Mr. Johnnie Banks, is the investigations team lead. His team is located in Washington, D.C., and he led the investigation of NDK Crystal. Mr. Banks has worked for 22 years at the Chevron Texaco Corporation Refinery in Richmond, California, prior to joining the CSB.

Mr. Banks is a graduate of the University of California Berkeley, and is a certified fire and explosion investigator.

Ms. Tyler is a licensed, certified safety professional, and has participated in several CSB investigations, and supported the development of significant recommendations for combustible dust regulations. She holds a Bachelor's of Science degree in industrial health and safety from the Pennsylvania State University.

I would like then to ask Mr. Johnnie Banks to take over the microphone and continue the meeting.

MR. BANKS: Thank you. Chairman

Moure-Eraso, Board Member Rosenberg, Board Member Griffon, Mr. Loeb, ladies and gentlemen, good morning. We're prepared to present the findings from the investigation of a fatal pressure vessel rupture that occurred at the NDK Crystal facility in Belvidere, Illinois.

This incident occurred on December 7, 2009, and resulted in one public fatality, and there was also one public injury, and significant property damage to NDK and a neighboring company.

Before I start, I'd like to introduce the team. I'm Johnnie Banks, and I am the investigator in charge of this investigation. And joining me from Washington, D.C. is Lucy Tyler, who was not able to travel with us to Belvidere today, but played a vital part in the development and bringing of this report to a conclusion.

I'd like to also go over the agenda for the presentation. The agenda for

today's meeting will include a presentation by the investigation team, which will include an animation of the incident, and a summary of the team's key findings.

This will be followed by a reading of proposed recommendations. The board will then have an opportunity to ask questions of the investigation team, and we will then hold a public comment period. Finally, the board will vote on the investigation team's report, and draft recommendations.

The CSB deployed to the NDK facility two days after the incident. The investigation team interviewed witnesses, collected company documentation, and participated in metallurgical examinations and testing of failed vessel fragment.

As a result of the investigation, the CSB identified several issues that contributed to the incident at various stages of the design and operation of the vessels, as well as deficiencies in vessel oversight and

inspections.

I'll now summarize the key issues identified. First, there was improper material selection, and excessive wall thickness contributed to the vessel failure mechanism, stress corrosion cracking. In addition, the lack of a regular vessel inspection program by the company and state fire marshal allowed the conditions resulting in the vessel rupture to go undetected.

Finally, investigation findings from a previous incident involving vessel lids did not prompt the company to take proper actions to ensure vessels were safe for operation. These key issues will be discussed in further detail in today's presentation.

The company overview, Nihon Dempa Kogyo, known as NDK, was founded in Japan in 1948. The company produces synthetic crystal quartz used for oscillators and ultrasonic transducers typically found in cell phones and other electronic devices. Over time, NDK

expanded its production and marketing globally.

The Belvidere facility is the only NDK Crystal production facility in the United States. The plant was built in 2002, adjacent to Interstate 90, about 75 miles northwest of Chicago. The NDK Crystal facility shares a property with NDK America, the sales and marketing portion of the company, and is located in a light industrially zoned area.

Here is a photo of the NDK facility two days after the explosion. This was taken across the interstate. The five-story plant housed eight pressure vessels. Nearly all of the building panels on the exterior walls were blown out as a result of the explosion.

Here we have an overhead photo of the NDK facility and the surrounding area, with points of interest labeled, including Interstate 90, the neighboring company, and the I-90 toll rest stop where the fatal injury

occurred.

At this time, I will turn the proceeding over to Ms. Tyler, who will start with the process discussed of the crystal growing process at NDK. Ms. Tyler?

MS. SCIALLO-TYLER: Good morning. NDK operated eight pressure vessels, called autoclaves, to synthesize the quartz crystals. The purpose of the crystals - the purpose of the vessels, I'm sorry, was to simulate natural geologic crystal growth through high pressures and temperatures. The vessels were forged from a solid bar of alloy steel and heat treated. There is one point of entry at the top of the vessels.

Here is a cross-section drawing of the NDK crystal growing vessels. The vessels stood 50 feet tall, with an inside diameter of just over two feet. They weighed 140,000 pounds.

The walls of the vessels were eight inches thick in the center cylindrical

sections, and then were much thicker at the top and the base, measuring over 18 inches thick at the top, and 16 inches thick at the bottom.

The process at NDK began with raw mined quartz, or lasca, as depicted in the photo to the right. These baskets were lowered into the bottom of the vessels.

Next, operators added a sodium hydroxide and water solution, and then hung sea crystals in racks at the top of the vessel. The sea crystals were thin, pure quartz, with the desired grain structure, upon which the larger synthetic crystals would grow.

Operators sealed the vessels, and external heaters raised the inside temperature to 700 degrees Fahrenheit. The boiling contents increased the internal pressure to 29,000 pounds per square inch. Over 100 to 150 days, the vessels remained at this temperature and pressure while the synthetic

crystals grew on the seed racks.

Here is a photo of the finished product. Mr. Banks will now hold up a sample of the synthetic crystal. Once removed from the process, the formed crystals were inspected at NDK and sent to Japan for further processing.

Now we will move on to a video that depicts the violent explosion of the vessel and its impact on the surrounding community. This animation is an excerpt from a longer safety video about the NDK investigation, and reiterates some of the process information I just presented, in addition to the incident animation.

The full length video titled, "Falling Through the Cracks," will be available on the Chemical Safety Board's website www.csb.gov after today's public meeting.

[VIDEO BEGINS]

NARRATOR: NDK Crystal operated a

synthetic quartz crystal manufacturing facility in an industrial area adjacent to Interstate 90 in Belvidere, Illinois. NDK produces large crystals used for a variety of products, particularly electronic devices.

The facility housed eight massive cylindrical pressure vessels, with eight inch thick steel walls, standing 50 feet tall. Inside the vessels, raw mined quartz or silica was used with a corrosive sodium hydroxide solution at extremely high pressures and temperatures.

The vessels were kept sealed for up to 150 days to allow the growth of large, single crystals of quartz. The silica and sodium hydroxide react with iron in the walls of the steel vessel forming a layer of sodium iron silicate, or acmite.

The company believed this acmite coating would protect the vessels from the corrosive effects of the chemicals inside. Over the years, NDK was warned that corrosion

might be compromising the walls of the pressure vessels, yet the company continued to operate these vessels without performing recommended inspections.

On December 7, 2009, pressure vessel number two was 120 days into a routine 150-day crystal growing cycle when suddenly, at about 2:30 p.m., it violently ruptured. Large pieces of structural steel were thrown from the building.

One piece was blown 650 feet toward a gas station on the Illinois tollway. Tragically, the building fragment struck and killed a driver who was walking back to his truck.

A large piece of the pressure vessel tore through an exterior wall of the NDK facility, skipped across a neighboring parking lot, and struck the wall of an adjacent automotive supply company where nearly 70 people were working. One was injured.

[VIDEO ENDS]

MR. BANKS: Go ahead, Lucy.

MS. SCIALLO-TYLER: To summarize, the incident at NDK resulted in one public fatality, a truck driver who was struck by the flying building fragments, and an injury to an employee working at the neighboring business.

There was also severe property damage to the NDK Crystal production facility, the adjoining NDK office area, the neighboring automotive supply company, and several nearby parked automobiles.

Now I will discuss the findings of the metallurgical testing and examinations that were conducted as part of our investigation. To investigate the immediate cause of the vessel failure, the CSB first had to determine if the failure was due to a process upset during the crystal run or a problem with the pressure vessel itself.

The investigation team reviewed control system data for the vessel two

production run and found no evidence of a temperature or pressure excedent that would have caused the vessel to rupture. Also, the vessel's rupture discs did not activate, which suggests that the vessel suddenly failed during the run, possibly due to a problem with the vessel construction.

As a result, the CSB entered a joint metallurgical testing agreement with other agencies and interested parties to physically examine the failed steel vessel in an attempt to characterize what caused the wall to suddenly give way and result in a violent explosion.

Here is a photo of the 8,600 pound vessel two fragment recovered from the damage at the neighboring facility. It's about eight feet long and four feet wide. This piece was used for all the metallurgical testing conducted as part of the investigation.

If you recall the cross section vessel from the earlier drawing and the video,

this piece came from the bottom portion of the cylinder just near the base where the wall thickness starts to make the transition between eight to 16 inches thick.

The CSB found strong evidence of cracking near the inner diameter of the vessel fragment. These cracks led to large flaws, one of which resulted in the catastrophic failure in December 2009. Stress corrosion cracking, or SCC, was the likely failure mechanism that caused the cracks.

Stress corrosion cracking is caused by the combination of applied stresses such as the high operating pressure inside the vessel, and a corrosion environment. The sodium hydroxide and water solution, generally known to damage some steels, was degrading the vessel wall over time, and likely resulted in the development of the stress corrosion cracks.

Here is a micrograph of a crack found on the fracture surface of the 8,600

pound steel fragment from vessel two. The CSB had independent metallurgical experts from NIST, or the National Institute of Standards and Technology, review the testing data. According to NIST, the branching of these cracks is a telltale sign of stress corrosion cracking.

A mineral called acmite, or sodium iron silicate, is naturally formed during the crystal growing process, and rapidly coats the inner walls of the vessels. Presence of acmite has been well documented in crystal growing operations since the 1950s.

The purpose of the acmite is to improve product quality by preventing impurities in the vessel walls from contaminating the product quality of the synthetic crystals. The acmite also forms a barrier between the caustic environment and the inner surface of the vessels.

NDK relied on this acmite layer to protect the inner walls from corrosion by the

caustic sodium hydroxide. High strength, low alloy steels, such as the material chosen for the NDK vessels, are inherently susceptible to stress corrosion cracking, especially under these conditions. Metallurgical testing suggests the acmite was not protecting the vessel, resulting in environmental damage to the inner wall.

Testing also revealed that chemical elements such as titanium and aluminum, known impurities found in the lasca, and sulfur and chloride were present on the inner surfaces of the cracks. Therefore, the process fluid was able to penetrate the surface cracks on the vessel.

This indicates the cracks were preexisting, and the acmite layer may have been removed by unintended surface scratching or mechanical abrasions during the loading and unloading of the vessels, allowing the inner surface of the vessels to come in contact with the degrading environment inside.

The 2009 rupture was not the first indication that there were problems with stress corrosion cracking in the vessel. In 2007, another vessel experienced a high pressure leak of hot caustics from the vessel lid operation. No one was injured, but there was significant damage on the 5th floor of the NDK production building.

Metallurgical testing showed evidence of stress corrosion cracking as the mechanism of failure that contributed to the 2007 leak, suggesting the acmite layer was not protecting the inner surface of the vessel lid from the caustic solution.

As a result of the 2007 lid failure investigation, metallurgical consultants and the insurance company recommended that NDK not place the vessels back into service as four of the eight vessel lids showed evidence of cracking.

They recommended thorough inspections of all the vessels based on

recognized industry practices, and warned that a catastrophic failure may be imminent in a letter directed to NDK.

The consulting company warned NDK in their August 2007 letter that a catastrophic rupture could occur as exhibited in the first excerpt from that letter, which I will now quote. "Unfortunately, far more catastrophic scenarios are possible.

If a crack were to grow to a critical size in which the stress intensity of the crack tip exceeded the failure toughness of the high strength steel used in the vessels, a catastrophic rupture could occur."

The letter went on to specifically list the scenario in which a member of a public, or anyone who might happen to be at the Belvidere Oasis, could be at risk for serious injury or death.

"We are bringing this letter to your attention because as professional engineers registered in the state of Illinois,

we have an obligation to protect the welfare of the public.

In this case, the public would include the employees of NDK Crystal Incorporated, any visitors in or around the NDK facility, and anyone who might happen to be at the Belvidere Oasis on the northwest toll road, if one of these two vessels were to fail catastrophically." A strikingly similar scenario occurred in December of 2009.

The incident in 2007 was the first indication of an issue with the vessels, either the protective capability of the acmite layer was compromised, or another general damage mechanism was occurring in the vessel material.

But despite these warnings, NDK repaired the lids and placed the remaining vessels back into service without identifying the origin of the stress corrosion cracking, or thoroughly examining the impact this was having on the interior of the vessels.

NDK had no regular inspection program for the interior of the vessels, and no certified inspectors ever entered vessel number two throughout its service life. Documentation revealed NDK was planning on replacing the vessel, but had not done so by the December 2009 incident.

Now I will discuss the regulations and agencies that govern NDK and its pressure vessel operation. The table shown here represents different levels of oversight, federal, state and local, that regulated worker and public safety as it applied to the NDK facility.

OSHA, the Occupational Safety and Health Administration, and the EPA, Environmental Protection Agency, provide federal oversight. Both OSHA and EPA conducted inspections of the NDK facility after the December 2009 incident and issued citations.

There were no specific regulatory

standards or programs that regulate the process at NDK such as the OSHA process safety management program or the EPA risk management program. OSHA cited NDK mostly for general industry safety violations.

Within the state of Illinois, the Office of the State Fire Marshal boiler and pressure vessel safety division regulates all the pressure vessels in the state. The vessels at NDK were subject to the requirements of the division.

And at the local level, the City of Belvidere Building and Zoning Department established zoning and permitting for the construction and operation of the NDK Crystal facility in 2001 and 2002.

Within the state of Illinois, the Division of Boiler and Pressure Vessel Safety, which is part of the Office of the State Fire Marshal, regulates the construction, installation, inspection, operation, and repair of all boiler and pressure vessels in

the state.

The Illinois Pressure Vessel Safety Act establishes the rules for the division, and adopts the requirements set forth in the American Society of Mechanical Engineers Boiler and Pressure Vessel Code and the National Board Inspection Code.

Shortly after the first three vessels at NDK were manufactured, the vessel fabricator could not certify that the vessels met the requirements of the ASME code. Specifically, the material was not meeting the toughness properties required by ASME for that type of material.

NDK petitioned the state of Illinois for an exemption that would allow the operation of those vessels without an ASME code certified stamp. The division coordinated an independent review of the vessel design specifications and granted permission for the operation of the vessels under the rules of the state Pressure Vessel

Safety Act.

In reviewing the design and operation specifications for the NDK vessels as part of the approval process, the division of pressure vessel safety did not identify the NDK vessel contents, specifically the sodium hydroxide solution, as corrosive to the steel materials of construction.

They classified the vessel as non-corrosive. And as a result of this classification, the vessels were not subject to internal inspections normally required for vessels with corrosive contents under the state Boiler Pressure Vessel Safety Act.

In addition, the vessel manufacturer recommended annual inspections to the state as part of the petition process. However, the state did not conduct internal inspections, nor did they have a process to ensure NDK was performing the recommended internal inspections on the three vessels that did not meet the ASME code required

properties.

When the state did conduct vessel inspections in 2003, 2006 and 2009, they inspected only external and accessible surfaces of the vessels.

Now I'll move on to the city of Belvidere. The land NDK occupies, originally undeveloped agricultural land, between Interstate 90 and Route 20 in Belvidere, was zoned in 1996 as light industrial, office, and research space for economic development.

In 2001, NDK petitioned the city of Belvidere, the Planning and Zoning Commission, and the Building Department, for permission to build the NDK facility, and permission was granted. The 1994 Belvidere zoning code was the governing document at the time the facility was zoned, and established what types of industry were permitted in light versus heavy industrial zones.

In reviewing the 1994 Belvidere zoning code, the CSB determined that the type

of production at the NDK facility, that includes the operation of eight heavy pressure vessels at extremely high temperatures and pressures, is more closely aligned with the uses permitted only in heavy industrial zones.

According to the code, heavy industrial zones would be grouped in a zone separate from residential and commercial activities, such as the highly populated Tollway Oasis across the interstate from NDK.

Light industrial uses include manufacturing and production processes such as automotive repair shops, lumber yards, office buildings, and warehouses. This would lessen the potential to have impact on the surrounding areas.

Heavy industrial uses listed in the code include the storage and manufacturing of products such as coal, coke, and tar, fertilizers, metals, rubber and paint manufacturing, and oil and petroleum refining.

The city of Belvidere did not

identify NDK as a risk to public safety in 2001, and no off-site consequence analysis was conducted to consider the impact of a vessel rupture on the nearby interstate and tollway rest stop.

Furthermore, the documentation NDK submitted to the city did not include details of the pressure vessel process, which may have led to a more in depth review of the potential risks.

The current issue of industrial zoning and land use planning remains a focal point for current and future CSB investigations, as exhibited by the NDK investigation, and more prominently in the recent West Fertilizer ammonium nitrate storage facility explosion in West, Texas, where 14 people were killed.

There may be an opportunity to improve zoning codes and ensure industrial facilities are zoned properly, and commercial and residential areas are not built up around

industrial facilities that have the potential for significant off-site consequences.

Now we will move on to the industry codes and standards that apply to the pressure vessels used at NDK. The American Society of Mechanical Engineers, or ASME, is a professional organization that develops standards for industry.

The boiler and pressure vessel code provides the requirements for the design, fabrication, and inspection of boilers and pressure vessels, and is generally accepted as the code that governs the rules for these components.

The ASME boiler and pressure vessel code was adopted by the state of Illinois in 1976. Section 2, Part A, of the boiler and pressure vessel code includes material specifications for pressure retaining components.

It covers the requirements that govern the material selection and construction

of forged and heat treated high strength steel vessels like the ones used at NDK. The code has a recommended wall thickness limitation for blind end vessels, or vessels with one open end, and that limit is seven inches thick.

However, the NDK vessels were designed with an eight inch thick wall in the center portion, and the top and the bottom of the vessels got as thick as 18 inches.

Evidence from the 2007 and 2009 incident metallurgical examinations suggest that the excessive wall thickness at NDK resulted in improper manufacturing, and contributed to the metallurgical damage mechanism that led to those failures.

Now, one would assume that a thicker steel would mean a stronger steel, or a steel that is less susceptible to damage or fracture, but there is an important safety reason that these limitations exist in some applications.

Vessels that are too thick may not achieve the optimal properties during the heating and cooling processes that take place during manufacture, for these limits ensure proper heat treatment for heavy walled vessels, and reduce the susceptibility for the types of damage mechanisms identified in our metallurgical examination.

Section 2 of the boiler and pressure vessel code lacked strict limitations for pressure vessel wall thicknesses for the types of steel used at NDK. The seven inch thickness limit is a typical maximum section size for that type of forged material, and it's not a required property like some of the other requirements that exist for ASME code compliance.

And the code does not include additional guidance for the heat treatment of vessels with larger wall thicknesses or wall thickness variations. However, the ASME has made some changes to the boiler and pressure

vessel code that impact the future construction and operation of vessels similar to NDK's.

In a subsequent issuance of the boiler and pressure vessel code since the NDK incident, the ASME revised Section 8, Division 3, the code for high pressure vessels, to allow the appropriate enforcing authorities, such as the state, to prohibit the use of alloy steel used at NDK with aqueous contents like the sodium hydroxide and water solution, because the material is more susceptible to environment stress corrosion cracking when in contact with those environments.

As a result, another type of alloy steel with properties less susceptible to stress corrosion cracking would have to be used in the future for this type of process.

Now I will list the key findings identified in the CSB investigation of the NDK Crystal incident. Key finding one: stress corrosion cracking likely caused the

catastrophic failure of the high pressure crystal production vessel at NDK Crystal Incorporated, fatally injuring a member of the public 650 feet away at a highway rest stop.

Key finding two: NDK relied upon the in-process formation of an acmite coating inside the production vessel to protect the low alloy, high strength steel from caustic sodium hydroxide use in the process. However, NDK did not verify the integrity or the effectiveness of this coating, and the caustic chemicals promoted stress corrosion cracking that weakened the vessel.

Number three: The board of boiler and pressure vessel safety did not conduct internal inspections of the NDK vessels as required under state regulations for pressure vessels subject to internal corrosion. Instead, the state says it relied on the company to perform internal inspections, but did not verify whether these were actually occurring.

The state conducted three certificate inspections of the vessel that failed in 2003, 2006, and 2009, less than three months prior to the incident, but these inspections focused only on accessible external surfaces.

Key finding four: In 2007, NDK learned that stress corrosion cracking was occurring in four of the eight pressure vessel lids at the facility. A consultant to NDK's insurance company warned NDK of serious reservations about returning the vessels to service after this discovery, and specifically cited the possible danger to members of the public at the nearby rest stop in case of a catastrophic vessel failure.

Key finding number five: Despite the insurance company warning, NDK did not perform recommended non-destructive examinations of all the vessels prior to returning the vessels to service.

Key finding six: NDK did not

perform annual internal inspections as recommended by the vessel designer when the vessels were initially constructed.

Key finding seven: Temper embrittlement, or some other form of heat treatment embrittlement, cannot be ruled out as a contributing factor in addition to the stress corrosion cracking. The vessels exceeded the ASME wall thickness recommendations for closed end forging, which may have resulted in improper heat treatment during the manufacturing process.

And key finding eight: The ASME boiler and pressure vessel code does not have specific wall thickness limitations for pressure containing components.

And now Mr. Banks will return to read the investigation team's proposed safety recommendations. Thank you.

MR. BANKS: Thank you, Ms. Tyler. It dawned on me when I was asked to hold up the finished product that I was behind this

podium, and some of you may not have been able to see it, so this is what it looks like. This is the finished product.

I'll now give you an overview of the recommendations process. It's our agency's primary tool to improve industrial safety practices and programs, and these recommendations can be issued to not only the entity where the incident occurred, but to federal and state regulatory improvements, industry and company. It addresses industry and company practices, and to trade associations, and standards and outreach.

The recommendations directly address incident findings and causes. It focuses on management systems to improve and prevent recurrence. We have a recommendations department that is tasked with following these recommendations through to closure, and they monitor and issue updates that can be tracked on our website, www.csb.gov/recommendations.

The first of the recommendations for this incident are directed to the American Society of Mechanical Engineers or ASME. It reads, "Revise the ASME boiler and pressure vessel code to include specific material thickness limitations for the design of pressure containing components to ensure heat treatment and avoid environmentally induced damage mechanisms.

Clarify required vessel wall thickness limitations for SA-723 steel in the following code sections: A: ASME, BP, VC, Section 2, Part A, Material Requirements, and B: ASME, BP, VC, Section 8, Division 3, Article MKM-400, Material Design Data."

The next recommendation is directed to the National Board of Boiler and Pressure Vessel Inspectors, or NBBI, and we urge them to communicate the findings of this case study to pressure vessel inspectors in all 50 states.

At a minimum, send the information

such as an article summarizing the investigation to each member who is a pressure vessel inspector, and to post a direct link to the NDK case study on the National Board's website.

Recommendation number three is to the Office of the Illinois State Fire Marshal Boiler and Pressure Vessel Safety Division, and it urges them to prohibit the use of existing pressure vessels at the NDK facility for crystal growing operations.

Also, to the Illinois State Fire Marshal Boiler and Pressure Vessel Safety Division, we recommended that they develop and implement state requirements and procedures to ensure pressure vessel approval process accurately, identifies vessels that may be subject to corrosion or similar deterioration mechanisms, and ensure regular inspections in accordance with the state requirements.

To NDK Crystal Incorporated, we recommend that they, for the design and

operation of any new NDK Crystal facility using a hydrothermal or equivalent crystal growing process, that it ensures that the facility uses a process that is rigorously - that rigorously demonstrates to be inherently safer than the existing process. For example, they're using lower temperature and pressures, and less corrosive conditions.

Also to NDK Crystal, we urge them to implement a program to ensure the ongoing integrity of any coating used on the new process vessels. Employ an expert, for example a coating expert, certified by NACE or the National Association of Corrosion Engineers, to design the program.

Also to NDK Crystal, we urge them to implement an annual inspection and corrective action program to ensure vessels remain resistant to environmentally induced damage mechanisms based on the inspection guidelines set forth in the American Petroleum Institute or API standard 510 pressure vessel

inspection code.

And finally, to NDK Crystal, we ask them to provide a copy of this study to the city of Belvidere building and zoning department, and the Illinois Boiler and Pressure Vessel Safety Division.

The concludes my portion of the presentation. I'll now turn the proceedings back over to the Chair and the Board. Thank you.

CHAIRPERSON MOURE-ERASO: Thank you very much, Mr. Banks. Now I'll continue with the agenda. I'm going to ask the board members if they have any questions for Ms. Tyler or Mr. Banks. So, we'll start with Board Member Griffon.

MEMBER GRIFFON: Sorry, I got to put the mic on. This one probably is more directed to Lucy, but I'll - either one of you. In the findings, you talk about stress corrosion cracking was the likely cause, but in the report you also indicate that temper

embrittlement can't be ruled out.

Can you tell me what effect determining that immediate cause, if any, had on your ultimate recommendations, and how you narrowed it down to SCC, stress corrosion cracking, being the more likely cause?

MS. SCIALLO-TYLER: Sure, though our expert metallurgists concluded that stress corrosion cracking was the likely failure mechanism, they also found evidence of temper embrittlement as a failure mode.

And temper embrittlement, though it really wasn't explained in the presentation this morning, there is more detail in our report, but it's a property that is inherently present in alloy steels of this type that are heat treated and quenched as part of the manufacturing process.

And our metallurgists concluded that temper embrittlement may have been acting in addition to the stress corrosion cracking, and this is based on some of the testing that

they did. And just looking at some of the mechanical properties of the vessel, they only found evidence of it, but weren't able to say that it was the most likely scenario.

I think that the stress corrosion cracking was a little bit more evident in some of the tests that they performed. And another part of that is the fact that the vessel fragment itself, the 8,600 pound piece, was the only piece that they examined.

They didn't look at the thicker regions of the vessel. And the one thing that we learned as part of our investigation is that the manufacturer - I'm sorry, actually I think the vessel fabricator, was having problems with quench cracks during the fabrication of the first - the initial first two vessels, which were eventually discarded.

And that, in conjunction with some of the findings from the vessel lid failure, we concluded that due to the excessive thickness of the vessel, the thicker regions

may not have achieved the appropriate grain structure or the properties during the heating and quenching process, and it may have increased the susceptibility of the vessel to crack under those very stressful, internal stress process conditions.

MEMBER GRIFFON: Thank you. And the second part was assuming you can't rule out the one, how important would that be to determine which one, in terms of your ultimate recommendations? In other words, was it necessary, or would it have likely resulted in similar recommendations that you have here?

MS. SCIALLO-TYLER: I think that, at least for the recommendations that we made to ASME, we kind of wanted to address both aspects of that. So, they had previously made changes to the code to prohibit the use of that type of steel or those types of environments, so that kind of rules out the whole stress corrosion cracking issue.

But, part of our recommendation to

ASME addresses that wall thickness issue that may have contributed to the temper embrittlement that was noted by our expert metallurgists. So, our recommendation is kind of two-fold in that it addresses both aspects.

MEMBER GRIFFON: All right, thank you. And I have a few more, but I'm willing to alternate if we -

CHAIRPERSON MOURE-ERASO: Yes, Member Rosenberg?

MEMBER ROSENBERG: Thank you, Chairperson Moure-Eraso. I wanted to ask the team, is the permitting process connected in any way with insurance coverage?

MS. SCIALLO-TYLER: The permitting process for the -

MEMBER ROSENBERG: To operate these vessels.

MS. SCIALLO-TYLER: For the construction of the facility, or are we talking about the vessel certification process?

MEMBER ROSENBERG: Yeah, exactly, to operate the vessels.

MS. SCIALLO-TYLER: Well, I can say that I know that as part of the Boiler and Pressure Vessel Safety Act, there are some responsibilities for the insurance agencies as far as notification. Would you like me to expand on that?

MEMBER ROSENBERG: I'm just wondering, is there a way we can use either insurance coverage or the permitting process to guarantee more safe operation of these vessels?

MS. SCIALLO-TYLER: Well, what I can tell you is one thing that we learned by, you know, reading the Boiler and Pressure Vessel Safety Act, at least in the state of Illinois, that the insurance agencies that insure facilities that have boiler and pressure vessels do have responsibility as to notify the chief inspector if they are involved in an auditor inspection of a

facility and notice a risk, and actually suspend their coverage of the risk.

So, that's one way that I know based on, you know, the state rules, that the inspector would be involved with the permitting, if you will, of the pressure vessels.

MEMBER ROSENBERG: Okay, thank you.

CHAIRPERSON MOURE-ERASO: Let me add one and then I'll come back you, Mark. Who knew in NDK about the warning from the insurance company, and when were they informed of the warning? And also, why do you think, and I'm asking either of you, the company ignored these warnings of the insurance company?

MS. SCIALLO-TYLER: Okay, I can answer that, Johnnie, but feel free to weigh in whenever. Based on the documentation the CSB reviewed, only NDK, and the insurer, and the consultants that did the work and issued

the initial letter, knew of the warning at that time.

And to answer the second part of your question, why did they ignore the warnings from the company? Well, from what we learned, that NDK did not feel that the failure scenario listed in the consultant's letter would produce the same outcome as stated in the warning.

NDK was planning to purchase new vessels. However, they had not done so by the time of the fatal accident. But we also learned that this was not the only recommendation from the NDK insurance company that NDK received and remained unfulfilled at the time of the incident.

It was noted by the insurance company that their safety program was somewhat informal, lacking formalized job training, standard operating procedures, and an injury and incident notification and investigation program.

So, this is kind of part of a trend there, you know, a consistent trend in their performance with, you know, their approach to internal safety.

CHAIRPERSON MOURE-ERASO: Thank you. I have another question. The - was the zoning as, you know, the classification of the NDK production as a light industry, have an impact on the accident that happened? I mean, if they would have been classified as a heavy industry, do you think that would have an effect on the zoning and this could have been prevented?

MS. SCIALLO-TYLER: It's kind of hard to say just because the way in which the vessel exploded and the distance that the fragment traveled was such a random event. But, I think that the facility may have been located in a different place because the heavy industrial zoning portion is in another area. It could have been located farther away from any sort of commercial activity.

I'm not quite sure if it would have been further away from the interstate. But it was noted that, you know, when we looked at the initial zoning and permitting for that facility, that it was put into light industrial, and we didn't feel that the type of process there really classified as light industrial. It was more heavy industrial.

CHAIRPERSON MOURE-ERASO: Thank you.

MS. SCIALLO-TYLER: And was there a second part of your question?

CHAIRPERSON MOURE-ERASO: No, I mean, it was right. I think you answered it.

(Laughter)

MEMBER GRIFFON: Lucy, I'll give you the second part of the question. Did the team consider making recommendations for changing that code, in other words, how they classified light or heavy or -

MS. SCIALLO-TYLER: Yeah, we looked at the 1994 Belvidere zoning code, and

of course the code has changed considerably over the years. And the current version of the code does have more strict requirements for heavy and light industrial zones. There's performance standards for heavy industrial zones.

So, there's definitely a little bit more oversight with regard to public safety listed in the code now versus 1994. However, I'm not quite sure, you know, if someone similar to NDK were to come to construct and operate a facility, you know, how the city of Belvidere would approach that zoning. But I will say this, the code has changed somewhat.

MEMBER GRIFFON: Okay, and I have a - going in a slightly different direction with this question. But, did - in the course of the investigation, did you guys - do you have any number - I'm just curious, like the numbers of these types of pressure vessels, and I don't even know how they're necessarily

classified.

But pressure vessels that operate at these high pressures in Illinois or in the United States, I mean, do we have any sense of the breadth of this hazard?

MS. SCIALLO-TYLER: I can say that as far as, you know, the number of heavy pressure vessels like, you know, the temperature or the pressure that NDK was operating at, I don't have a number on that.

MEMBER GRIFFON: Okay, all right. And the only other thing was I know -

MS. SCIALLO-TYLER: I mean, I can also add that, you know, that we do know that there's another process similar to NDK that does operate in the country, but their process and the pressures that they use, though they're pretty high, are not quite as high as NDK's.

MEMBER GRIFFON: All right. And then just my last question, I know, it was mentioned, and I realize that this operation

isn't covered under process safety management regulations, but did the team look at whether these type of pressure vessels should be included in a process safety management type of regulation, or have similar components as the process safety management rules such as process hazard analysis, those kind of components?

MS. SCIALLO-TYLER: Yeah, the team examined this, and basically it came down to the fact that the, you know, what puts processes under or to be covered under the PSM standard is based on the chemical quantity or, you know, the capacity -

MEMBER GRIFFON: Right.

MS. SCIALLO-TYLER: - of the vessels to have a certain amount of a highly hazardous chemical or a flammable material. And these vessels did not contain enough, you know, enough of a hazardous quantity of chemicals or hazardous materials. They would not be covered.

So, I think that, you know, it is worth examining that, you know, there are some aspects of the PSM program that might have been somewhat beneficial with regard to the operation and inspection of these vessels, such as process hazard analysis or a robust mechanical integrity program that would have encompassed some of the recognized and generally accepted engineering practices that govern the inspection of pressure vessels such as the API codes.

MEMBER GRIFFON: And I raise it realizing the threshold quantities wouldn't have been met in this case, and I think that might be a limitation of our process safety management rule, but also we've learned recently it, you know, even in the UK they have similar restrictions on their high hazard facility regulations. So, it's just something I thought is interesting maybe to consider out of this case. Thank you.

CHAIRPERSON MOURE-ERASO: Thank

you. I have one last one, Lucy.

MS. SCIALLO-TYLER: Okay.

CHAIRPERSON MOURE-ERASO: Could you sort of expand a little of what is the safer process that could be used to produce this silica crystals? What is the difference between the safer process and this process? I mean, can you give some details?

MS. SCIALLO-TYLER: Sure, I mean, we've briefly researched other crystal growing operations in the United States. We've found only one other company that makes synthetic crystals similar to NDK's, and they're located in Ohio. We learned that the company uses vessels that are smaller and thinner, and they run at lower temperatures and pressures than the ones used at NDK.

And though we did not do an in depth analysis of the overall risk associated with this process, it appears that it may be an alternative to the NDK process which requires such a high amount of pressure and

temperature inside the vessels which ultimately can pose a risk to worker and public safety.

CHAIRPERSON MOURE-ERASO: Do you remember the numbers? I'm curious about the difference between the pressures and temperatures from NDK and this Ohio process. What was the difference in numbers? The question again, I wonder if you remember the numbers, I mean, how much lower was the pressure and how much lower was the temperature?

MS. SCIALLO-TYLER: I'm sorry, I don't quite have that information available, but - I would have to check back for you. It's in our report.

CHAIRPERSON MOURE-ERASO: Okay, yeah, thank you. I'm just curious. Thank you very much. So, there is not any more questions from the board, okay. So, I would like to call the CSB managing director, Dr. Daniel Horowitz, to ask him to facilitate the

public comment if you would to. I understand you have a list. So, Dr. Horowitz?

DR. HOROWITZ: Thank you, Mr. Chairman. If you've signed up, that's great. If you haven't signed up, it's not too late. You're certainly welcome to comment as well. It's a - okay. It is a -

SPEAKER: Daniel, you might want to pull the mic over.

DR. HOROWITZ: Okay. It is a small group, so you're all welcome to comment if you wish. First commenter is Crispin Hales of Hales and Gooch, Limited, and I believe representing Traveler's Insurance. Dr. Hales, could you step up to the microphone? And could you please spell your name for the transcript? Thank you.

DR. HALES: Yes, it's Crispin Hales, C-R-I-S-P-I-N H-A-L-E-S. And really, this is a personal thing that I've been involved in many investigations, and I really appreciate what the CSB has done on this

particular investigation and the way it's been presented to us today, and the detail in which you've gone into this particular failure.

It's absolutely crucial within the U.S. that we take note of these type of accidents. And again, very sad that a person had to lose their life in order for this to be looked at in this kind of detail that we're looking at it today. Thank you.

DR. HOROWITZ: Thank you, Dr. Hales. And next is John Morawetz of the International Chemical Workers Union. John, could you spell your name, please?

MR. MORAWETZ: John J-O-H-N Morawetz M-O-R-A-W-E-T-Z. A few questions similar to the board asking questions. One is, is it in the report, I'm not sure, I didn't see it, were there workers at the facility in a control room when this incident took place?

DR. HOROWITZ: I think we can answer that. Lucy, were you able to hear, or

Johnnie, were you able to hear that?

MR. BANKS: Yes, there were. There were workers at the site.

MS. SCIALLO-TYLER: Yes, yes, there - I think there may have been, and I believe it's in the report, I think there may have been about five or six workers in the NDK Crystal facility present, and then over in the NDK America, the adjoining office area, I don't remember the exact number, but there was a pretty high number of office workers that were there that day.

MR. MORAWETZ: And how far was that facility, was the office area from the vessel that erupted?

MS. SCIALLO-TYLER: It was in the same building, if you will, it was just an adjoining building. So, I mean, I probably couldn't give you an estimate on the number of feet, but, you know, I would say like less than 100 feet away.

MR. MORAWETZ: And was it in a

sort of protected environment, explosive proof, or anything like that better constructed? Basically, were these workers at risk, and more importantly, is this in the report? I haven't had a chance to read the detail in the report yet.

MS. SCIALLO-TYLER: I can say that the - that there was - that there were no injuries. There was some pretty significant damage to that office area as a result of the rupture. I mean, there was a lot of broken glass. There was a lot of disturbed furniture, walls, loss of power. So, the office area that does connect itself, you know, the NDK America office area was severely damaged by the vessel rupture.

MR. MORAWETZ: And more importantly, is that covered in the report?

DR. HOROWITZ: Not specifically in terms of the office area, John, but it does talk in general that this facility and the other facilities were not prepared for this

sort of catastrophic scenario. Clearly I think that comes across through the whole investigation.

MR. MORAWETZ: There's a particular personal reason why I would raise that.

DR. HOROWITZ: Yeah, go ahead. Why don't you - if you can, give us your comment - give us your questions. At the end, we'll try to -

MR. MORAWETZ: Okay, well, in particular, in September 2012, we lost two members in Memphis, Tennessee, where a vessel erupted. They were in the control room. They were not protected and they both died. So, it's a particularly important issue for us. And I would urge the board to put that in the report, in the case study. I know it's not a full report.

Otherwise, you know, in particular, it's interesting that the truck driver is called the public, although I

understand it's not a member of the work force at this facility, I assume he was a driver, he was at work.

And in particular, I've talked to Lamont Byrd, the head of the Teamsters Union Health and Safety Department, and they have a concern about truck drivers who go in and out of facilities, as well as the whole issue of siting, that clearly this facility was so close to any area, gas pumps, and all the rest of it, that vividly you show in the video is included, and its exit at work.

If I can just transition with time being short, and I believe this comment is going to be submitted to you. I have a comment I'd like to read into the record on behalf of the steel workers.

"On behalf of the" - and I got this, this morning. "On behalf of the 850,000 United Steel Worker Members, we appreciate the opportunity to provide a comment for the record even though we were unable to attend

this public meeting in person.

The USW has had no direct involvement with the NDK Crystal incident. However, we certainly are very interested in some issues the incident raises. This incident involved an off-site facility, off-site injuries, and damage to off-site property.

The CSB is currently investigating several incidents involving off-site consequences that the USW is directly involved, including the recent incident at the Chevron facility in Richmond, California, where approximately 15,000 people from the surrounding community went to the hospital after the crude unit fire.

The USW is very concerned about incidents directly affecting the workers, but also we understand that high hazard facilities also pose a risk to the community and the environment.

The USW is looking forward to the

CSB's findings and recommendations related to safety siting and reducing the risk to the communities in which our members work.

We also wish to submit into the record" - and I assume they'll it to the board - "our continued and repeated concern pertaining to time limits to the CSB investigation reports. The investigation being discussed today is nearly four years old.

The Tesoro investigation is almost four years old, and is not the only long delayed CSB report. At a CSB public meeting in January of 2012, the USW asked for the CSB to hold a public meeting to discuss the problems associated with the backlog of CSB reports.

On November 8, Mike Wright of the USW submitted a letter to the CSB board members requesting clarifications on committments made by CSB board chair, Moure-Eraso, at the USW's 2013 health safety and

environment conference in Pittsburgh. I request that letter to be included in the record of this meeting.

The letter asked for clarification on the completion dates, and focused on several open investigations which involved USW representative workers, including the April 2010 Tesoro investigation, the 2009 Citgo investigation, the 2010 Horsehead zinc investigation, and the apparent commitment by the board chair to initiate a study on all U.S. oil refineries that use hydrofluoric acid.

We again urge the CSB to hold a public meeting in Washington, D.C., to review and discuss the backlog of investigative reports, providing an opportunity to update interested stakeholders on these important issues."

And let me also say that the Teamsters wrote to me saying that the Teamsters are also concerned about safety in

these facilities. Our members both in trucking and rail operations deliver materials to manufacturing facilities, and they have pressurized vessels on site.

Let me just add that I think the point that they raise about CSB meetings are important. I think the board should discuss and have a plan, and goals, and time lines on the back log. I think we appreciate this report being completed, being one of the older reports, and we're pleased that's happening.

Also, in terms of goals on the general cases that are outstanding, clearly one big one that's not mentioned by the steel workers is Deepwater Horizon. As I think everybody in the room is painfully aware, it takes a lot of staff time and resources, and I would urge that that could be wrapped up. I hope there are some goals, certainly before the fourth anniversary of that disaster, that that can be addressed or put to bed and behind you.

And lastly, I would hope that - I'm not sure, and it maybe a question for you, Daniel, is whether usually are preliminary findings or PowerPoints that are distributed before the meeting? That would be helpful for those of us to attend the meeting to make informed comments at the meeting and get more out of it.

Similarly, it's nice having a video feed I would hope for some of us. I know for some interested parties, that it would be helpful to have a phone-in line where people can comment. Thank you very much.

DR. HOROWITZ: Thank you, John. And in answer to your earlier point, we're also concerned about the issue of control room siting. We've made a number of recommendations actually from other cases.

Johnnie Banks was involved with the Carbide Industries investigation that we completed actually earlier this year. Two workers there were actually killed in a

control room that was not safety sited.

Also, our STEREOGENICS? ***8:15:56 cases. DELEC? was a case that the prior chairman had dropped, but the other three cases, there are reports on our website, and so, you can see those recommendations. And we certainly share your concern about that issue. And thank you for traveling here for the meeting.

Next is Dr. William J. O'Donnell with O'Donnell Consulting Engineers. Dr. O'Donnell? And I understand you're the chair of the ASME subcommittee involved in writing standards for this particular area.

DR. O'DONNELL: Yeah, that's right. I am chairman of the subgroup on fatigue strength for the last 45 years. And I can say that this vessel did not meet our requirements, but the requirements may not have been as explicit as they appear to us to be, in particular in the area of stress corrosion cracking, which is the problem here.

This vessel didn't meet safety margins for stress corrosion cracking. In fact, the safety margins were very close to one. And I'm not allowed, by the way, to speak for the code. The code has 1,000 volunteers, and they don't like one person speaking for them.

So, I'm speaking as a person who is published in this field, and who is recognized sort of for these fatigue cracking, stress corrosion cracking, crack growth, metallurgy, those areas. I spent the last 50 years of my life in those areas.

And I want to say that I think that this investigation was extremely well conducted. I couldn't believe that all of these metallurgical issues got pulled in by the team. They went to other parts of the government to get this expertise. They got it.

They got very good reports from them. They converted it into this draft

report, which usually when you get a report from a metallurgist, nobody can read it but the metallurgist, and they have converted this into common sense that everybody can understand what the hell happened.

I think it's extremely well balanced, the report. It doesn't surprise me that it took four years. It's taken us four years. We're trying to tie up any loose ends that still may be in the code ***8:18:29.

And codes and standards are usually written by engineers for use by engineers, and are sometimes not the best.

So, I really was quite impressed with the report, and ***8:18:53.

And they were hoping the acmite layer was going to be okay, but they didn't do any testing of it, and that, in my mind, does not meet code. ***8:19:18.

So, I really am complimenting the investigative committee going out and getting all the different expertise they needed and

putting them together in the right way. It was really a remarkable achievement.

And I really only have one - being an engineer, of course, I mean, we get very meticulous, and there was - the one thing I would like to see changed in the recommendations was the one that was put up here, the R5 that was up on the board.

And the R5 said that they want NDK Crystal to ensure that the facility uses a process that is rigorously demonstrated to be inherently safer than the existing process. That ain't good enough. Being safer than zero is not, you know. From an enginnering point of view, that's not what you want to do.

I think if you change that to say, "demonstrated to meet the safety margins of the ASME code for stress corrosion cracking," you know, that basically in the ASME code is a factor of three against bursting of pressure vessels.

And you can do a rigorous stress

corrosion cracking analysis, and you can get the damn safety margins, and those safety margins should meet code safety margins. So, that's really my only, you know, in all of this great work that was done here, that's the only thing I would change in the recommendations. I think it was extremely well done.

We heard a lot of stories from different people in the beginning of this thing, why this thing occurred that were technically sound. The board did not bite on any of those. Some of those were brought to my committees. We said, "No, the physical evidence doesn't support what you're claiming."

And I was very much afraid that they - that some people who were claiming these things would convince the board that they were true. So, one of the reasons I'm here was to make sure that doesn't happen.

(Laughter)

DR. O'DONNELL: So, thank you very much.

CHAIRPERSON MOURE-ERASO: Thank you.

DR. HOROWITZ: Thank you, Dr. O'Donnell. We appreciate it. Is there anyone else who did not sign up who would like to comment? Well, I think that's it, Mr. Chairman.

CHAIRPERSON MOURE-ERASO: Thank you, Dr. Horowitz. So, we move to the board consideration of the product. So, I make a motion. I move that the board approve the NDK Crystal Incorporated Belvidere, Illinois high pressure vessel rupture case study identified as CSB Investigation Number 2010-04-IL for Illinois, and all associated video products. Do I hear a second?

MEMBER ROSENBERG: I second.

CHAIRPERSON MOURE-ERASO: Is there any discussion, more discussion of this?

(NO AUDIBLE RESPONSE)

CHAIRPERSON MOURE-ERASO: So, I ask for general council to please proceed with the vote.

SPEAKER: The question is on the floor. Thank you, Mr. Chairman. I will take the roll. Member Rosenberg?

MEMBER ROSENBERG: Aye.

SPEAKER: Member Griffon?

MEMBER GRIFFON: Aye.

SPEAKER: Mr. Chairman?

CHAIRPERSON MOURE-ERASO: Aye.

SPEAKER: There you have it.

(Laughter)

CHAIRPERSON MOURE-ERASO: Excellent. So, I guess the matters of this meeting have been all covered, and I declare this meeting finished.

(Whereupon, the meeting adjourned at 12:01 p.m.)