

U.S. CHEMICAL SAFETY AND  
HAZARD INVESTIGATION BOARD

+ + + + +

T2 Laboratories Explosion and Fire

+ + + + +

Public Meeting  
Jacksonville, Florida

Marriott Hotel Jacksonville  
Florida Room  
September 15, 2009

+ + + + +

6:00 p.m.

PRESENT:

JOHN BRESLAND, Chairman

GARY VISSCHER, Board Member

WILLIAM WARK, Board Member

WILLIAM WRIGHT, Board Member

CHRIS WARNER, General Counsel

TABLE OF CONTENTS

Opening and Introduction. . . . . 3

Investigation Report. . . . . 9

Board Questions . . . . . 35

Vote. . . . . 71

Adjourn

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

2 (6:00 p.m.)

3 CHAIRMAN BRESLAND: We'll be  
4 starting in about 30 seconds so if I could ask  
5 everybody to take a seat and we'll get going.

6 That's the official gavel. Good  
7 evening and welcome to the public meeting of  
8 the U.S. Chemical Safety Board or as we know  
9 it the CSB. I'm John Bresland, Chairman and  
10 CEO of the board. With me today are board  
11 members Gary Visscher on my right, William  
12 Wark and William Wright on my left. Also  
13 joining us is our General Counsel, Chris  
14 Warner, and CSB staff members whose efforts  
15 have facilitated this evening's meeting.

16 The CSB is an independent  
17 non-regulatory federal agency that  
18 investigates major chemical accidents of fixed  
19 facilities.

20 Our investigation examines all  
21 aspects of chemical accidents including  
22 physical causes related to equipment design as

1 well as inadequacies in regulations, industry  
2 standards and safety management systems.

3           Ultimately we issue safety  
4 recommendations which are designed to prevent  
5 similar accidents in the future.

6           The purpose for this evening's  
7 meeting is to allow the CSB investigative team  
8 to present their findings. The board members  
9 will then vote on the final report into the  
10 December 19th, 2007 explosion and fire at the  
11 T2 Laboratories in Jacksonville, Florida.

12           Following that presentation we  
13 will open the floor to comments from members  
14 of the public who are here this evening. The  
15 meeting will conclude with a discussion by the  
16 board and the vote on the final report.

17           Before we begin I'd like to point  
18 out some safety information. Please take a  
19 moment to note the locations of the exits from  
20 this meeting room. The exits are at the back  
21 of the room and over here and lead to the  
22 outside in case of an emergency.

1           I also ask that you please mute  
2 your cell phones so that these proceedings are  
3 not disturbed. I'll pause and give you a  
4 second to mute your cell phones. Thank you.

5           At 1:30 p.m. on December 19th,  
6 2007 an explosion destroyed the T2  
7 Laboratories facility in Jacksonville. A  
8 runaway reaction occurred during the  
9 production of methylcyclopentadienyl manganese  
10 tricarbonyl, or MCMT as we'll refer to it this  
11 evening. It resulted in an explosion and  
12 fire. It killed four employees and injured  
13 four others. It also injured 28 members of  
14 the public.

15           The incident at T2 Laboratories  
16 included one of the most powerful explosions  
17 that the CSB has ever investigated, a blast  
18 that was felt 15 miles away in downtown  
19 Jacksonville. Debris from the explosion was  
20 found up to one mile away. The blast damaged  
21 buildings within one quarter mile of the  
22 facility. This was a tragic unnecessary loss

1 of life and the CSB immediately began an  
2 investigation.

3 Many of you here this evening were  
4 affected by the devastation that resulted from  
5 this incident. To those of you in the audience  
6 who lost friends, family members or were  
7 yourself injured by the incident, please allow  
8 me to extend my deepest sympathy.

9 Let me explain the process the  
10 board follows to complete an investigation:

11 Each independent board member, the  
12 four board members who are here this evening  
13 have had an opportunity to study the draft  
14 report. At this public meeting we will hear  
15 a presentation by the investigation team. The  
16 board members may direct questions about the  
17 investigation to the team. There will then be  
18 a board member vote on the report and its  
19 recommendations.

20 Our objective is to leave here  
21 this evening with strong effective  
22 recommendations based on the report's

1 findings. The board's goal is that the report  
2 and it's recommendations will help prevent,  
3 and I emphasize prevent, similar accidents in  
4 the future.

5           If anyone in the audience wishes  
6 to comment publicly after the investigations  
7 -- the investigators' presentation, please  
8 sign up at the table in the check-in area and  
9 I will call your name at the appropriate time.  
10 However, if you haven't signed up we certainly  
11 will offer the opportunity for additional  
12 people to make comments also. Please note  
13 that we will have to limit the public comments  
14 to three minutes each.

15           Also note that we are not able to  
16 take questions for the investigators directly  
17 from the audience so I'll ask that all  
18 questions or comments be directed to me as the  
19 presiding official. If there's a point that  
20 it raised in your comment where I believe the  
21 investigation staff can provide some immediate  
22 clarification, I will ask them to do so.

1 I would like to thank the team for  
2 their diligent work on this investigation.

3 I will now recognize any other  
4 board members for an opening statement.

5 Mr. Visscher?

6 MR. VISSCHER: I have none.

7 CHAIRMAN BRESLAND: Mr. Wark?

8 MR. WARK: I have none.

9 CHAIRMAN BRESLAND: Mr. Wright?

10 MR. WRIGHT: I have none.

11 CHAIRMAN BRESLAND: Thank you.

12 At this time I'll ask the  
13 investigation supervisor Robert Hall to  
14 introduce the investigation team.

15 Mr. Hall is a Registered  
16 Professional Engineer with a bachelor's degree  
17 in nuclear engineering and a master's degree  
18 in mechanical engineering. He has more than  
19 25 years experience in the design, inspection  
20 and evaluation of hazardous systems for the  
21 chemical, nuclear and the aerospace  
22 industries. Mr. Hall served as the



1 investigator in charge for this investigation.

2 Now let me turn it over to Mr. Hall.

3 MR. HALL: Thank you, Mr.

4 Bresland.

5 With me tonight is the team that  
6 helped me investigate this accident. On the  
7 far end of the table Mary Nikityn. She holds  
8 a bachelor's degree in psychology from  
9 Southern Adventist University and is currently  
10 a doctoral student in clinical psychology at  
11 George Washington University. Prior to  
12 joining the CSB Ms. Nikityn worked as a  
13 regulatory specialist in the compliance  
14 training industry with expertise in EPA  
15 hazardous waste and DOT hazardous materials  
16 regulation.

17 Next to Mary is Lucy Sciallo. She  
18 is a graduate out of Pennsylvania State  
19 University with a Bachelor of Science degree  
20 in Industrial Health and Safety. Prior to  
21 joining CSB Lucy worked in the oil industry as  
22 a health and safety specialist. She holds a

1 Graduate Safety Practitioner designation from  
2 the Board of Certified Safety Professionals.

3           And lastly Mr. Jeffrey Wanko. Mr.  
4 Wanko received a bachelor's degree in chemical  
5 engineering from Syracuse University and a  
6 master's from the Illinois Institute of  
7 Technology. Mr. Wanko has been a safety  
8 professional for more than 16 years  
9 specializing in process safety in the  
10 pharmaceutical, specialty chemical and food  
11 sectors. Mr. Wanko is a licensed Professional  
12 Engineer and a Certified Safety Professional.

13           Chairman Bresland, members of the  
14 board, Chief Counsel, ladies and gentlemen,  
15 good evening.

16           The investigation team is pleased  
17 to present the facts, findings and causes of  
18 the runaway reaction, explosion and fire that  
19 occurred at T2 Laboratories in Jacksonville on  
20 December 19th, 2007.

21           The incident at T2 laboratories  
22 included one of the most powerful explosions

1 that the CSB has ever investigated, a blast  
2 that was felt 15 miles away in downtown  
3 Jacksonville. The explosion caused wide  
4 spread community damage, flinging debris in  
5 all directions. Four T2 employees were  
6 skilled. T2 employees and many members of the  
7 public working at nearby businesses were  
8 injured. Dozens of firefighters spent many  
9 hours battling the chemical fire. Businesses  
10 were damaged. Buildings had to be demolished  
11 and rebuilt. And the environmental clean up  
12 is still ongoing.

13           The impact of this incident on the  
14 community was severe and the CSB has spent  
15 many months researching and analyzing the  
16 incident in the hope of preventing future such  
17 occurrences. Tonight we are presenting our  
18 findings and recommendations to both the board  
19 and the Jacksonville community.

20           The presentation includes a  
21 summary of the incident, a computer  
22 reenactment of the most likely scenario as

1 well as the presentation of the team's  
2 findings and recommendations. Following the  
3 presentation we'll have an opportunity for the  
4 public to comment and the board will vote on  
5 the team's report and recommendations.

6           Before I discuss the incident I'd  
7 like to give you a very brief background on 2T  
8 Laboratories.

9           T2 Laboratories, which is no  
10 longer in business, was a chemical  
11 manufacturing facility located on the north  
12 side of Jacksonville. T2 began as a specialty  
13 solvent blending company in 1996. In 2000 T2  
14 began research and development on a  
15 manufacturing process for a chemical called  
16 methylcyclopentadienyl manganese tricarbonyl  
17 or MCMT.

18           Over the next few years T2  
19 designed and built the chemical process line  
20 and began producing MCMT at the Faye Road  
21 site. By 2007 at the time of the incident T2  
22 had 12 employees and had manufactured 174

1 batches of MCMT. T2 produced MCMT from 2004  
2 until the incident in 2007 selling it under  
3 the tradename Ecotane.

4 MCMT is used as an octane booster  
5 in gasoline and is sold in the U.S. primarily  
6 as a specialty product in automotive stores.

7 T2 sold MCMT to a U.S.  
8 distribution company and other companies  
9 internationally. MCMT is highly toxic through  
10 inhalation and skin absorption. It is  
11 regulated by the Environmental Protection  
12 Agency as an extremely hazardous substance.  
13 T2 manufactured MCMT in a single reactor in  
14 batches using a three-step chemical process.

15 On the morning of December 19th,  
16 2007 T2 began producing its 175th batch. The  
17 reaction proceeded normally throughout the  
18 morning; however, shortly after 1:00 p.m. a  
19 cooling problem was reported. The reaction  
20 temperature began to rise past the normal  
21 operation point and the reaction proceeded  
22 uncontrollably. As temperature and pressure

1 rapidly increased, the reactor burst and its  
2 contents exploded in a blast equivalent to  
3 1400 pounds of TNT. Video footage shows the  
4 very energetic nature of this explosion.

5           This first clip was taken by an  
6 infrared surveillance camera located several  
7 miles away. The two large cooling towers that  
8 you see in the center of the screen are 460  
9 feet high. As the heat from the blast  
10 dissipates, you can see smaller objects  
11 twinkling. These are like pieces of sodium  
12 metal from inside the reactor reacting with  
13 the moisture in the air as they fall.

14           You can also see a smokestack in  
15 line with the explosion. This smokestack is  
16 640 feet high.

17           This business is located about 620  
18 feet from the reactor structure. The building  
19 was damaged and eight of the 16 employees  
20 working there were injured.

21           This business is located about 700  
22 feet away. As you see in the security video,

1 debris rained down on the workers outside.  
2 Inside workers looked towards the reactor  
3 shortly before being showered by glass as the  
4 windows shattered.

5           This is an aerial photograph of  
6 the T2 site the day after the incident. Here  
7 in the center you can see the area where the  
8 reactor structure stood. Large pieces of the  
9 reactor shell were thrown here and here.

10           Another large piece of the reactor  
11 weighing about 2000 pounds was found about 400  
12 a feet away in this direction. Two steel  
13 columns that supported the reactor were found  
14 a thousand feet down Faye Road in both  
15 directions.

16           This area of the facility was the  
17 tank farm and contained thousands of gallons  
18 of flammable solvents. After the explosion  
19 those ignited and continued to burn for many  
20 hours.

21           The control room where two T2  
22 employees were killed was a square 12-foot

1 concrete building located here just 50 feet  
2 from the reactor. As you see the damage on  
3 site was devastating. The damage off site and  
4 the impact to the community were also  
5 extensive. The explosion killed four T2  
6 employees and injured 31 of 118 people that  
7 were working within a thousand feet of the  
8 reactor.

9           One T2 employee sustained  
10 life-threatening injuries that required  
11 extensive hospitalization.

12           Many of the injuries to people  
13 working in nearby businesses were caused by  
14 secondary missiles as pieces of structure,  
15 office furniture and glass shards were thrown  
16 by the blast.

17           Five buildings belonging to  
18 businesses on Faye Road sustained so much  
19 damage that they were condemned as unsafe  
20 structures and had to be rebuilt. Debris flew  
21 in all directions throughout a one mile  
22 radius.



1           This building is near T2. Is it  
2 one of those that was condemned as unsafe.  
3 The business had to relocate operations while  
4 the building was reconstructed.

5           You see here a trailer used by a  
6 trucking company adjacent to T2. This  
7 structure was destroyed by the blast shortly  
8 after trucking company employees had been  
9 dismissed for the day. Had anyone been working  
10 here, it is likely they would have been  
11 severely injured or killed.

12           Many organizations responded to  
13 the large explosion, huge fire and extensive  
14 damage. The City of Jacksonville Fire and  
15 Rescue Department and the sheriff's office  
16 managed the incident. While the Environmental  
17 Resource Management Division assessed the  
18 environmental impact and the Planning and  
19 Development Department surveyed damage and  
20 condemned unsafe structures.

21           The Naval Air Station Mayport and  
22 the Jacksonville International Airport Fire

1 Department helped fight the blaze. The  
2 Florida Department of Environmental Protection  
3 and the American Red Cross responded to  
4 oversee site clean up and assist emergency  
5 workers respectively.

6           The emergency response to this  
7 incident was excellent as many of the agencies  
8 cooperated to safely control the fires and  
9 event further harm. Over 90 firefighters  
10 entered the fight to battle the chemical fire.  
11 None were injured.

12           Due to the impact of this  
13 incident, the CSB decided to deploy a team on  
14 December 19th. The team arrived in  
15 Jacksonville on the next morning and began the  
16 investigation activity but was unable to enter  
17 the site for another five weeks because of the  
18 highly toxic MCMT and the difficulty of  
19 testing for its presence on site.

20           While waiting to access the site,  
21 the team conducted many investigation  
22 activities. The team conducted 48 interviews

1 with T2 employees and eyewitnesses from other  
2 businesses. We also examined the reactor  
3 vessel fragments found on site and collected  
4 more parts of the reactor from the surrounding  
5 woods.

6           The team examined and catalogued  
7 all of the damaged structures and used this  
8 information to determine the strength of the  
9 explosion. The CSB submitted dozens of  
10 document requests to T2 and other companies  
11 and agencies and reviewed thousands of  
12 documents received in response.

13           Finally the CSB recreated T2's  
14 chemical reaction in a laboratory and  
15 duplicated the runaway reaction that occurred  
16 on December 19th. A reenactment of what most  
17 likely occurred is presented as an animation  
18 which is part of a CSB full safety video on T2  
19 which will be released soon. I will now  
20 present the animated reenactment to you.

21           VOICEOVER: "T2 produced MCMT, a  
22 gasoline additive in batches using a 2500

1 gallon reactor. An operator controlled the  
2 process with a computerized system in a nearby  
3 control room. In the first step liquid  
4 chemicals and sodium metal were loaded into  
5 the reactor, heated and then mixed with an  
6 agitator.

7                   "The reaction produced hydrogen  
8 which was vented to the atmosphere. In normal  
9 operations when the temperature reached 300  
10 degrees Farenheit the operator would turn off  
11 the heating system. But because this reaction  
12 was exothermic or heat producing, the  
13 temperature inside the reactor would continue  
14 to rise.

15                   "At 360 degrees operators would  
16 begin to periodically fill the reactor's  
17 cooling jacket with water. As the water  
18 boiled heat was removed controlling the  
19 temperature.

20                   "However, on the day of the  
21 accident the CSB found that the operator tried  
22 to cool the reactor as usual but the cooling

1 system likely malfunctioned perhaps due to a  
2 blockage in the water supply piping or a valve  
3 failure. The temperature and pressure inside  
4 the reactor began to rise in a runaway  
5 chemical reaction.

6 "T2's co-owners returned to the  
7 plant after a worker called to report the  
8 cooling problem. While one owner searched for  
9 the plant mechanic the other went to the  
10 control room. Concerned about a possible  
11 fire, he warned employees to move away from  
12 the reactor.

13 "Inside the reactor the pressure  
14 was still increasing reaching 400 pounds per  
15 square inch and bursting the rupture disk.  
16 Witnesses heard a sound like a jet engine as  
17 high pressured gas began to vent from the  
18 reactor. But it was too late. Within ten  
19 seconds there as a massive explosion  
20 equivalent to about 1400 pounds of TNT."

21 MR. HALL: As you've just seen in  
22 the animation, the explosion that occurred at

1 T2 was very powerful and destroyed the  
2 facility. The following photos show the same  
3 views of T2 before and after the incident.

4 I will now present the team  
5 findings that the team determined from the  
6 investigation.

7 Based on our evidence collection,  
8 the team identified several key investigation  
9 areas. First the chemistry used by T2 was  
10 exothermic or heat producing. Exothermic  
11 chemistry presents specific hazards and  
12 requirements for reactor cooling and relief  
13 system design. Hazard recognition is of  
14 particular importance when designing  
15 exothermic chemical processes.

16 The team investigated T2's  
17 recognition of the reactive hazards as well as  
18 agitation on reactive hazards that are  
19 commonly provided to undergraduate chemical  
20 engineers. These areas were key in  
21 understanding incident causes and the team  
22 will present each one in more detail. First

1 Investigator Wanko will present the results of  
2 our chemical testing.

3 MR. WANKO: Thank you, Mr. Hall.

4 T2's owners based the process on a  
5 three-step chemical recipe they found in  
6 patents dating back to 1950. The patents  
7 described the different chemicals that could  
8 be used to reach the final product, the  
9 intermediate steps and the processes  
10 condition. The patents though do not describe  
11 the safety measures that must be in place for  
12 full scale production.

13 The patents also do not address  
14 the heat production or exotherm that occurs in  
15 the first step of the process. The first step  
16 was about two and a half hours into the  
17 production of the batch when the incident  
18 occurred.

19 The first stage of the process  
20 required initial heating to start the  
21 reaction. At a predetermined set point  
22 heating is shut off as the reaction produces

1 enough heat to sustain itself. At this point  
2 the reaction requires periodic cooling to  
3 remove heat from the system.

4           The team hypothesized that an  
5 uncontrolled chemical reaction caused the T2  
6 explosion so we recreated the standard  
7 chemical recipe of the first step that T2 used  
8 and were using on the day of the incident.

9           The recipe included  
10 methylcyclopentadiene and diethylene glycol  
11 dimethyl ether, also known as diglyme, and  
12 sodium metal. Using only 50 grams of material  
13 in the same proportions as T2, the team found  
14 that the first step exhibits an initial  
15 exotherm or heat generating period that can be  
16 controlled through cooling and venting hot  
17 gasses.

18           However, above 390 degrees  
19 Fahrenheit, only 30 degrees higher than the  
20 normal operating temperature, a second  
21 undesired reaction occurs that exhibits a  
22 second and more energetic exotherm.



1                   If cooling or venting were to have  
2 failed during the first step of the process,  
3 temperature and pressure and therefore  
4 reaction rate would continue to rise.

5                   If conditions are not corrected  
6 quickly a second undesired reaction occurs and  
7 the temperature and pressure rises very  
8 quickly and uncontrollably.

9                   T2's development work was  
10 incapable of determining exothermic activity  
11 and this uncontrollable outcome went  
12 undetected.

13                   This graph illustrates the results  
14 of one of the teams' laboratory run using the  
15 T2 recipe of MCPD, diglyme and metal.

16                   Here in the first desired reaction  
17 temperature and pressure rise gradually over  
18 two and a half hours. At about 390-degrees  
19 Farenheit the second undesirable reaction  
20 begins. Then at about 500 degrees Farenheit  
21 the temperature and pressure rise very  
22 quickly.

1           In this region the temperature is  
2 rising at about 70 degrees Farenheit per  
3 second, and pressure at over 500 pounds per  
4 square inch per second.

5           Since this chemistry is so  
6 energetic we tested a very small amount in  
7 this apparatus. It's about half the size of  
8 a soda can.

9           Here you can see the test  
10 apparatus before and after the second  
11 undesired reaction which occurred with less  
12 than two ounces of material. The T2's reactor  
13 in contrast held over six tons during the  
14 first step.

15           With pressure rising over 500  
16 pounds per square inch per second, pressure  
17 inside the vessel reached 5000 pounds per  
18 square inch and burst in less than 10 seconds  
19 after the emergency vents opened.

20           Here you can see two large pieces  
21 of the reactor. This large piece is from the  
22 bottom of the reactor. And this piece is a

1 portion of the top weighing about 2000 pounds.  
2 It was thrown through a pipe rack, impacted  
3 and bent a railroad track and damaged a  
4 building about 400 feet away.

5 Mr. Hall.

6 MR. HALL: Thank you Investigator  
7 Wanko.

8 As you saw in the video, before  
9 the incident the reactor was held vertically  
10 in a tall steel support structure. The  
11 reactor itself was about ten feet high and  
12 seven feet wide.

13 As Investigator Wanko discussed,  
14 exothermic reactions generate high  
15 temperatures and pressure. To control these  
16 cooling and pressure release systems are  
17 extremely important. Cooling for the reactor  
18 was provided by an exterior cooling jacket.  
19 City water was piped in from the bottom of the  
20 jacket and allowed to boil and vent. The heat  
21 required to boil the water was taken out of  
22 the reaction.

1                   Water was piped into the jacket  
2 and boiled off repeatedly throughout the part  
3 of the reaction that required cooling.

4                   Pressure relief was provided at  
5 the top of the reactor via a one-inch center  
6 relief line. A four-inch emergency vent line  
7 was also at the top of the reactor. This line  
8 was closed until the reaction pressure reached  
9 400 pounds per square inch at which point a  
10 rupture disk burst opening the emergency vent  
11 line.

12                   On the day of the incident the  
13 reaction temperature rose uncontrollably  
14 likely because cooling was not applied to the  
15 reactor. The T2 operator reported a cooling  
16 problem about ten minutes prior to the  
17 explosion. When the team investigated this we  
18 found that the cooling system lacked  
19 redundancy. This means that a single failure  
20 of any one of several parts of the cooling  
21 system would cause the entire system to fail.

22                   Potential failure points included

1 the drain and supply valves, supply piping  
2 blockage, scale build up in the jacket or even  
3 a faulty temperature indicator. Because no  
4 emergency system was immediately available  
5 operators would need to manually attach hoses  
6 to access an additional water supply in the  
7 event of a failure. During the incident as  
8 the reaction quickly ran away operators would  
9 not have had the time to perform these  
10 necessary actions.

11 CSB investigators found that the  
12 emergency vent system was designed for normal  
13 operation and not designed to consider a  
14 runaway reaction. Additionally the set  
15 pressure of the emergency vents was set too  
16 high. Had it been lower it would have  
17 activated before the second exothermic  
18 reaction and could have stopped or slowed the  
19 runaway by venting at a lower pressure  
20 allowing chemicals to boil and remove heat and  
21 chemicals from the reactor.

22 Although T2 owners conducted

1 laboratory testing of the MCMT process  
2 chemistry, this testing did not look for the  
3 potential exothermic reaction in the first  
4 step of the process. The need to cool the  
5 first step was not identified until the first  
6 full-scale production batch.

7           Temperature control issues and  
8 near miss exothermic reactions occurred in  
9 three of the first ten production batches but  
10 T2's owners did not systematically investigate  
11 these anomalies to determine their cause.

12           Throughout the production history  
13 poor yields and batch flow variations  
14 occasionally occurred due to temperatures  
15 rising too high in the first step. However T2  
16 was never able to fully control these batch  
17 variations and continued to use the same  
18 recipe that it had established in the early  
19 batches.

20           Although T2's owners had chemical  
21 industry experience, neither had previously  
22 worked with reactive chemistry and hence did

1 not have any experience developing and  
2 designing a reactive exothermic process like  
3 the MCMT chemistry.

4           Additionally although T2 was owned  
5 by a chemist and chemical engineer, neither of  
6 them learned about process safety and the  
7 specific hazards of chemicals of reactive  
8 chemistry in their education program.

9           Chemistry programs are not  
10 intended to address process design and plant  
11 production. Chemical engineering programs,  
12 while they do cover process and plant design,  
13 often do not address process safety.

14           The Mary K. O'Connor Process  
15 Safety Center operated by the Texas A&M  
16 University developed programs to promote  
17 safety in the chemical industry.

18           In 2006 the center conducted a  
19 survey of undergraduate chemical engineering  
20 programs and found that process safety was a  
21 part of the required curriculum in only 11  
22 percent of the programs. Within these

1 specific inclusion of reactive hazard  
2 recognition and management was even more  
3 limited.

4           Recognizing the need for increased  
5 education and process safety in reactive  
6 hazards, the American Institute of Chemical  
7 Engineers, AIChE, designed and implemented a  
8 process safety certificate program which began  
9 issuing certificates in 2008. The process  
10 safety certificate program is free to members.  
11 It consists of four modules two of which  
12 specifically address reactive hazards. AIChE  
13 has more than 150 chapters and student  
14 membership is free.

15           Now to present the root and  
16 contributing causes as determined by the team.

17           The root cause of the incident was  
18 that T2 did not recognize the runaway reaction  
19 hazard associated with the MCMT it was  
20 producing. As a result the contributing  
21 causes were that the reactor cooling system  
22 was susceptible to single point failure and it



1 failed on the day of the incident. The  
2 reactor relief system was incapable of  
3 releasing the pressure from a runaway reaction  
4 which resulted in the reactor bursting and the  
5 contents exploding.

6           Since 1998 the CSB has  
7 investigated a number of reactive chemical  
8 accidents and in 2002 issued a comprehensive  
9 study of reactive chemical incidents. These  
10 investigations and the study included  
11 regulatory and industry recommendations aimed  
12 at reducing chemical accidents. The  
13 recommendations that we propose here today  
14 seek to further this work by addressing  
15 chemical reactive hazard recognition as part  
16 of chemical engineering undergraduate  
17 education.

18           Accreditation is a voluntary peer  
19 review process to assure quality and specific  
20 educational programs. The Accreditation Board  
21 for Engineering and Technology, or ABET,  
22 reviews degree programs in engineering,

1 including chemical engineering. Specialized  
2 curriculum criteria are used to review  
3 undergraduate chemical engineering programs.

4           The team recommends that the  
5 American Institute of Chemical Engineers work  
6 with ABET to add reactive hazard awareness to  
7 the required chemical engineering curricula  
8 and accredited programs.

9           The Process Safety Certificate  
10 Program which includes reactive hazard  
11 management is offered free to AIChE student  
12 chapter members. The team recommends that  
13 AIChE inform its student members about the  
14 process of specific programs and encourages  
15 student members to participate.

16           Mr. Bresland, at this point in  
17 time the team will entertain any questions  
18 that the board has regarding our report.

19           CHAIRMAN BRESLAND: I thank you,  
20 Mr. Hall and Mr. Wanko, number one for your  
21 diligent work on this and for your excellent  
22 presentation this evening.

1                   We will start on my left with Mr.  
2 Wark.

3                   MR. WARK: Thank you, Mr.  
4 Chairman.

5                   I do have a couple questions but I  
6 too would like to commend the investigators on  
7 an outstanding job. From all accounts this  
8 was an outstanding response to a very serious  
9 incident and I'd like to also commend the fire  
10 community, the other first responders for a  
11 job well done as well.

12                   I understand that you were delayed  
13 in getting onto the site because of the  
14 hazardous nature of the materials, the MCMT.

15                   How long was it before you could  
16 get on the site, if you haven't already  
17 mentioned that, and how was the entry made?

18                   MR. HALL: After the team arrived  
19 we quickly evaluated the hazards associated  
20 with the MCMT that T2 was producing. As I  
21 mentioned it's a regulated material by the EPA  
22 and it's on the list of extremely hazardous

1 substances.

2           As we investigated this we found  
3 that there were no commonly available  
4 immediate measurement techniques that could be  
5 used in the field to detect the MCMT. And we  
6 had to go through a lengthy process of taking  
7 samples and having them sent to a specialized  
8 lab of which there's only one in the country  
9 that does this analysis to determine the MCMT  
10 levels. And this kept us out of the very core  
11 of the site for five weeks.

12           I'd like to also point out that in  
13 the emergency response the fire community in  
14 entering the site wore protective gear that  
15 prevented any injury from this particular  
16 highly toxic material.

17           MR. WARK: I have just one more  
18 question and that is were there any off site  
19 exposures to the chemical?

20           MR. HALL: There were no recorded  
21 instances of off site exposure to this  
22 particular chemical. The chemical does break

1 down in sunlight so as it was released it  
2 broke down in a relatively short period of  
3 time so the real danger from exposure to this  
4 chemical was within the site, within the  
5 structures of the site where they were storing  
6 the MCMT where sunlight didn't reach.

7 MR. WARK: That's all I have, Mr.  
8 Chairman.

9 CHAIRMAN BRESLAND: Mr. Wright.

10 MR. WRIGHT: Thank you, Mr.  
11 Chairman.

12 I too would like to commend all  
13 those involved with this incident because I  
14 think they did an outstanding job. I have  
15 several questions for Investigator Hall. One  
16 having to do with our scaled down experiment,  
17 if you will, to replicate the explosion. You  
18 showed a picture of the vessel before and  
19 after it under went the secondary thermal  
20 reaction or exothermic reaction.

21 My question is did we scale down  
22 the vents on that particular vessel so it

1 replicated the same size vents as here?

2 MR. HALL: That particular test  
3 that was performed was performed in what's  
4 known as a closed cell, which is not a vented  
5 cell. In order to achieve the actual  
6 measurements of the heat production and the  
7 pressure rise, it's a standard practice to do  
8 that in a closed cell.

9 MR. WRIGHT: So we didn't have a  
10 relief valve?

11 MR. HALL: No, there was no relief  
12 valve.

13 MR. WRIGHT: And my assumption is  
14 because they were unaware of the hazards that  
15 they probably didn't conduct any hazard  
16 analysis.

17 My question is did you find any  
18 evidence of anybody performing any hazard  
19 analysis with respect to explosive impacts  
20 that may occur during the chemical runaway  
21 reaction.

22 MR. HALL: We did not find any

1 evidence of a hazard analysis being performed.  
2 We did find, however, and it's detailed in the  
3 report, that one of the consultants to T2 had  
4 recommended that they perform a hazard  
5 analysis and yet this recommendation was never  
6 followed up on.

7 MR. WRIGHT: My final question  
8 deals with the -- I believe I read in the  
9 report that they scaled up production more  
10 than once. Initially they started with a  
11 small vessel, table top if you will, analysis  
12 and then went to full production.

13 And then I believe they raised the  
14 level of the production again just before this  
15 incident?

16 MR. HALL: That is correct. They  
17 began their testing with a one-liter reactor,  
18 basically a table top device, and did their  
19 developmental work in that one-liter reactor  
20 and went straight to the large reactor that  
21 was in the incident.

22 For the first 42 batches they used

1 a recipe that was three quarters the size of  
2 the recipe that was used the day of the  
3 incident. So after batch 42 they began  
4 producing a larger quantity, increasing the  
5 quantity of chemicals in the reactor by one  
6 third. The importance of that is when you do  
7 that it increases the energy input and makes  
8 the situation more dangerous.

9 MR. WRIGHT: Thank you very much.

10 CHAIRMAN BRESLAND: Board member  
11 Visscher.

12 MR. VISSCHER: Thank you, Mr.  
13 Chairman. I want to join Mr. Hall and Mr.  
14 Wark in mentioning commending the emergency  
15 response community and the incident command.  
16 They talked about the fact that the response  
17 was done in a safe manner, which is the most  
18 important thing. And we mentioned, just so  
19 you know, the board recently issued a video on  
20 emergency response and one of the incidents  
21 that's held out as an example of good  
22 emergency response is the response to this



1 incident.

2           But I also wanted to mention I was  
3 a board member who went on at the time of the  
4 deployment and wasn't just, although as I  
5 said, the most important thing is the safety  
6 of the emergency responders. But I was so  
7 impressed by the incident command structure  
8 and how smoothly all those different agencies  
9 were able to work together. And that's to the  
10 leadership of the emergency response community  
11 and the fire department and the way in which  
12 that was handled.

13           So this isn't always the case on  
14 our deployments that everything goes so  
15 smoothly when you have so many different  
16 agencies and local and state and federal  
17 agencies involved.

18           We talk about these issues around  
19 the country I often use this as one where it  
20 really did go very smoothly and again a  
21 tribute to the leadership.

22           Question: I gather that the

1 company and the owners were aware of the first  
2 exothermic reaction but not the second one in  
3 that first step. They wanted the first one to  
4 happen.

5           They needed the first exothermic  
6 but they weren't aware of the second one was  
7 a possibility?

8           MR. HALL: That's correct. I mean  
9 we did find that actually in their  
10 developmental testing when they were testing  
11 it in a one-liter reactor they detected no  
12 exotherms. And wasn't until the very first  
13 production batch that they discovered the  
14 exotherm, the initial exotherm, in the first  
15 reaction. They did have occasions where they  
16 allowed the temperature to get too high but in  
17 every case they were able to stop this before  
18 it proceeded into the uncontrolled part of the  
19 second exotherm.

20           MR. VISSCHER: Is that also what  
21 happened, they had previous incidents where it  
22 had sort of gotten away?

1                   MR. HALL:  Gotten away but they  
2  reestablished cooling and were able to control  
3  the incident.

4                   MR. VISSCHER:  How many of those  
5  incidents, do you know?  Was that fairly  
6  frequent?

7                   MR. HALL:  WELL, the documentation  
8  of that is somewhat limited.  All the  
9  documentation was destroyed.  All the on site  
10 documentation destroyed and we were able to  
11 obtain some back ups from individuals that had  
12 documentation off site.  But in the initial  
13 batches, the first ten batches, three of those  
14 first ten had exothermic excursions that  
15 didn't fully run away but were a cause of  
16 great concern.

17                   MR. VISSCHER:  In each case they  
18 were able to bring those down by using  
19 cooling?

20                   MR. HALL:  By using cooling to  
21 slow it.

22                   MR. VISSCHER:  If you were

1 starting out a process and you wanted to know  
2 what those hazards were, one way to determine  
3 what those hazards were would be laboratory  
4 testing which they did some of I guess, but  
5 not as thoroughly perhaps.

6           What would be other -- how would  
7 you know what the hazards are?

8           THE WITNESS: Well, they did their  
9 laboratory testing in standard lab equipment.  
10 And there's a very specific test process  
11 that's used to evaluate exothermic hazards and  
12 they refer to it as a thermal hazard  
13 evaluation test where they used a very  
14 specialized device that minimizes heat  
15 transfer across the test cell and it more  
16 closely behaves like a full-scale reactor.  
17 And that was a test device that we had done  
18 our testing in that Investigator Wanko had  
19 shown that with just 50 grams of the material  
20 we were able to duplicate a burst vessel like  
21 occurred the day of the incident.

22           MR. VISSCHER: So they had done

1 laboratory testing but not necessarily the  
2 right kind or the laboratory testing that  
3 would show -- would indicate those kinds of  
4 reactions?

5 MR. HALL: That's correct.

6 Mr. VISSCHER: It would seem to me  
7 that another source of information about  
8 hazards would be a literature search.

9 Is there literature available in  
10 terms of the reactive hazards or the  
11 possibilities of an exothermic or runaway  
12 reaction of this in the literature? Is there  
13 a literature search?

14 MR. HALL: In looking at the  
15 literature that's available, and they did an  
16 extensive literature search in their  
17 development.

18 This material was developed in the  
19 late 1950s by a company called Ethol who got  
20 a number of patents for the material. There  
21 are some 25 or so patents that are listed in  
22 the appendix of the report. These patents

1 detail how the chemicals were combined to make  
2 this product. But the patents don't address  
3 hazards or safety aspects of the production.  
4 They're purely written to achieve getting the  
5 patent from the patent office to give them  
6 product protection.

7           Apart from the patent, MCMT from a  
8 production standpoint is largely absent from  
9 the literary universe. There is not much  
10 information out there on this particular  
11 material. The information that does exist has  
12 to do with the hazards and toxicity.

13           MR. VISSCHER: Presumably at least  
14 now there will be some literature with our  
15 report that will highlight some of the hazards  
16 to put other people on notice if anyone is  
17 thinking of producing it.

18           How did they decide on the rupture  
19 disk being set at 400 psig? Was there a  
20 formula that was used? I think the report  
21 indicated that if it had been set  
22 significantly lower that would have relieved

1 the pressure at a much earlier time.

2 MR. HALL: From our understanding,  
3 and there was very limited documentation on  
4 this. And this particular evidence comes from  
5 interviews and it's really secondhand  
6 information because those that had done this  
7 work were unfortunately killed in the  
8 accident.

9 The set point, the size and the  
10 set point were based on the normal production  
11 of hydrogen from the reaction and also looking  
12 at the MAWP of the vessel as well as all three  
13 steps and what pressure they wanted to operate  
14 all three steps of the chemical process at,  
15 not really focusing on the first step and  
16 looking at the exothermic requirements of the  
17 exothermic chemistry.

18 MR. VISSCHER: One last question,  
19 Mr. Chairman.

20 The recommendations really focus  
21 on improving education in chemical education  
22 for a better awareness of looking for

1 hazardous reactions or hazards of reactions.

2 Sort of a two-part question.

3 First, why did you focus on education in this  
4 report and second of all I think in your  
5 introduction the chairman mentioned that your  
6 own background is in nuclear engineering. If  
7 you would compare sort of the safety awareness  
8 in nuclear engineering to the safety awareness  
9 in chemical engineering.

10 I take it that what we're doing  
11 with this recommendation is urging that the  
12 chemical education process, the chemical  
13 process, chemical engineering education move  
14 in the direction of what's already been done  
15 in nuclear engineering.

16 Is that a fair assessment?

17 MR. VISSCHER: That's a fair  
18 assessment, Mr. Visscher.

19 When looking at this particular  
20 case we saw similarities with a number of  
21 other cases where you had a small  
22 entrepreneurial company that was going in and



1 developing a process using a highly hazardous  
2 reactive chemistry. In these small  
3 entrepreneurial companies each one had a  
4 similarity that there was really a lack of  
5 recognition that this hazard existed. When we  
6 looked at these small companies, typically  
7 they were unregulated. They were outside the  
8 regulatory environment. The owners were  
9 unaware of what happened.

10           And we've made regulatory  
11 recommendations. We made industry  
12 recommendations. We've made recommendations  
13 that reach out to the big chemical companies  
14 and we're really looking for a way as to how  
15 can we reach these small companies. And one  
16 of the answers is to reach through the  
17 education system. It's something we have not  
18 done in the multitude of reactive incidents  
19 that we've investigated.

20           And as you point out, within the  
21 nuclear industry there's a big emphasis on  
22 education and the learnings that go into the

1 initial process design and the like in making  
2 sure the people fully understand the hazards  
3 that they're dealing with and there are checks  
4 and balances in the learning aspect of it.

5 So in that respect that we had not  
6 previously gone this route as a presentation  
7 measure, we thought that it would be  
8 appropriate in this case.

9 MR. VISSCHER: Thank you, Mr.  
10 Chairman.

11 CHAIRMAN BRESLAND: Other board  
12 members for your questions.

13 I have a few questions myself.  
14 And let me start with I guess it's a follow up  
15 to Mr. Visscher's question, maybe in a more  
16 general sense.

17 We've had this explosion. We've  
18 had this tragedy with the four killings.

19 If you were to go back to the  
20 beginning here, what should have been done  
21 that would have prevented this accident from  
22 happening in terms of starting at the

1 beginning, developing the process, developing  
2 the information, designing the process and  
3 operating it?

4                   What could have been done that  
5 would have prevented this from happening?

6                   MR. HALL: Well initially in the  
7 developmental stage would be to perform the  
8 thermal hazard evaluation testing, to actually  
9 test for exothermic reactions and get the  
10 kinetic, reaction kinetic data to use in the  
11 process design. That was kind of the initial  
12 point that was missed in the process design.

13                   Secondly when we look at the --  
14 those first ten batches that they produced and  
15 we saw that they had ten occasions or three  
16 occasions in that first ten batches where the  
17 temperature went beyond what they had desired  
18 and indicating some exothermic activity that  
19 may not be desirable, they just kept going  
20 rather than stopping and trying to evaluate  
21 that. With each one of those they were able  
22 to catch it. The reactor didn't blow up.

1 They were able to move on. And they  
2 normalized that deviation.

3 And that's much the same way in  
4 the Challenger incident, how each time the O  
5 rings failed, NASA normalized the deviation.  
6 The shuttle didn't blow up. We launched again  
7 and eventually one caught them. And the same  
8 thing caught them here.

9 So there was multiple  
10 opportunities, multiple near misses that  
11 occurred throughout the production that were  
12 clues to what they should have done.

13 CHAIRMAN BRESLAND: So one of the  
14 things they should have done was the more  
15 sophisticated laboratory testing which I  
16 assume they didn't have the capability of  
17 doing.

18 How many laboratories are there in  
19 the United States that have the expertise to  
20 do this sort of testing? For example how much  
21 money did we spend on the testing?

22 MR. HALL: There's about six

1 laboratories in the United States that perform  
2 this testing commercially. Also some of the  
3 big chemical companies perform the testing  
4 internally. But those that perform it as a  
5 service there's about six laboratories in the  
6 country performing it commercially.

7           The CSB spent about \$125,000 to  
8 perform this particular test and got some of  
9 the top people in the country known for this  
10 particular type of testing to guide the test  
11 and evaluate the results.

12           CHAIRMAN BRESLAND: Who else makes  
13 this chemical in this country?

14           MR. HALL: There is one other  
15 domestic producer and that is a company called  
16 Afton. It used to be called Ethyl  
17 Corporation. And they have been producing  
18 this particular material since the late 1950s.

19           CHAIRMAN BRESLAND: Have they had  
20 any incidences that we know of?

21           MR. HALL: We found no record of  
22 incidents that they had had that were publicly

1 known.

2 CHAIRMAN BRESLAND: The vessel  
3 exploded at you say about 5000 psi and it was  
4 a three-inch vessel so it was a very  
5 significant explosion.

6 Assuming that it -- that the  
7 system was designed properly, how big would  
8 the rupture disk have to have been? Keeping  
9 in mind that the rupture disk is something  
10 that as you know is something that blows  
11 before the vessel blows so it avoids the  
12 catastrophic explosion of the vessel.

13 Do we know, do we have any  
14 estimates from any of our experts how big that  
15 rupture disk would needed to have been to  
16 avoid this catastrophic destruction of the  
17 vessel?

18 MR. HALL: From our testing we  
19 looked at what relief size. And there's two  
20 components to the relief size, the set  
21 pressure as well as the physical size. And at  
22 400 psi, which was the set pressure chosen by

1 T2, there was not a size big enough that would  
2 relieve the pressure and protect the vessel.

3           However, if you drop that set  
4 point down to 75 psi, and what this allows to  
5 happen is when it relieves at the lower  
6 pressure the chemicals inside the reactor  
7 immediately boil. And once they start boiling  
8 that removes heat as well as the chemicals  
9 then vent and it removes the chemicals from  
10 the reaction. So a relief device set at 75  
11 psi of approximately the size they had would  
12 have protected this vessel. But at 400 psi  
13 there was no way to relieve the pressure.  
14 There was not a device big enough.

15           CHAIRMAN BRESLAND: In your  
16 presentation, just changing topics here, you  
17 discuss the cooling system which is the -- not  
18 the emergency cooling system but the routine  
19 cooling temperature control system, but you  
20 said there was not a back up to that.

21           What would have -- in your  
22 experience what would a typical back up system

1 look like?

2 MR. HALL: Several of the  
3 employees at T2 indicated that they had a  
4 secondary source of water. It wasn't hooked  
5 up. And what we mean by hooked up is we would  
6 need a second line into the cooling jacket  
7 with its own dedicated automatic valve  
8 controlled by the control room. And because  
9 this secondary source that they were talking  
10 about just came from a tank, it would also  
11 need a pump or a power supply. So you would  
12 need a whole duplicate supply system that  
13 could feed water to the reactor jacket.

14 CHAIRMAN BRESLAND: I don't have  
15 any other questions.

16 Do any of the board members?

17 Board member Wark.

18 MR. WARK: Thank you, Mr.  
19 Chairman. Just to follow up with Mr. Hall.

20 My presumption is that if people  
21 were aware and that if the recommendation is  
22 heeded in the future, people will do a proper



1 hazard analysis and will be aware of what  
2 potential catastrophic events may occur and  
3 hopefully will then site their facilities in  
4 areas to prevent damage to their neighbors or  
5 neighboring businesses.

6 Am I correct in that presumption,  
7 that that's a hope that we have for the  
8 future?

9 MR. HALL: Yes, sir.

10 MR. WARK: Thank you.

11 MR. HALL: You know, we found with  
12 the T2 company that there were some hazards  
13 that they were aware of. And on those hazards  
14 they spent money and they took protecting  
15 action. But in this case it was a hazard they  
16 were unaware of and hence appropriately did  
17 not deal with it.

18 CHAIRMAN BRESLAND: Any other  
19 questions?

20 That concludes the questions from  
21 the board members. We did have a sign up  
22 sheet as people walked in and I have a copy of

1 it. I have the sign up sheet here but  
2 unfortunately it's blank. So I don't have  
3 any, but that doesn't prevent you from asking  
4 questions. So if there are members of the  
5 audience who would like to either make a  
6 comment or ask a question, please do so now.

7 With the gentleman here. If you  
8 would state your name, please, and spell your  
9 name for the person who is taking the  
10 dictation.

11 MR. McDONALD: George McDonald.

12 Had that jacket on the vessel been  
13 descaled or do you know if they regularly  
14 descaled that vessel, the water jacket?

15 CHAIRMAN BRESLAND: Let me repeat  
16 the question. The question as I understand it  
17 was had the vessel been descaled, meaning?

18 MR. OTHER: You have a water  
19 jacket around the vessel where you're putting  
20 the City of Jacksonville water.

21 MR. BRESLAND: You're asking if  
22 there was scale inside?

1                   MR. McDONALD: That's correct. It  
2 boils off so you get a limestone deposit  
3 inside the jacket. You could normally remove  
4 that with an acidic wash.

5                   Do you know if that was done?

6                   CHAIRMAN BRESLAND: Let me turn  
7 that question over to Mr. Hall.

8                   MR. HALL: We have no evidence as  
9 to whether or not that was ever done. We  
10 looked very carefully at the vessel and the  
11 jacket after the explosion but the explosion  
12 was of such magnitude that we felt that any  
13 scale that might have been there could have  
14 been taken off through the very energetic  
15 nature of the explosion. And it was listed as  
16 one of potential single point failures for the  
17 cooling system and it's one of the possible  
18 failures that the team considered causing a  
19 failure of the cooling system.

20                   MR. McDONALD: We've got a very  
21 hard water here, 175 without descaling it  
22 would have significantly reduced the ability

1 to cool.

2 That's all I have.

3 CHAIRMAN BRESLAND: We have  
4 someone else coming to the microphone. No, we  
5 don't. He's one of the audio/visual people.

6 Again if you could tell us your  
7 name and spell it, please.

8 MS. PADRICK: My name is Sandra  
9 Padrick, last name is P-A-D-R-I-C-K.

10 I'm curious about whether or not  
11 you're subject to standard -- but you did talk  
12 about the presence of solvents also in and of  
13 course if there were such they would have been  
14 required to conduct a hazard analysis. So .  
15 . .

16 CHAIRMAN BRESLAND: The question  
17 is were they covered by the OSHA process  
18 safety standard?

19 MR. OTHER: Yes.

20 CHAIRMAN BRESLAND: Mr. Hall.

21 MR. HALL: The first step of this  
22 process OSHA did extensive testing following

1 the accident to determine if the first step  
2 was not a covered step, would not be covered  
3 under process safety management because the  
4 mixture in the reactor did not meet the  
5 flammability requirement. None of the  
6 chemicals listed were covered chemicals so the  
7 flammability requirement was the only  
8 requirement they could have met and OSHA  
9 determined in their testing that it did not  
10 meet the flammability requirement.

11 We did find that T2 Laboratories  
12 never did any testing to determine whether or  
13 not they were covered and did not do what OSHA  
14 did to make a determination of coverage. And  
15 in fact there were several of the employees  
16 that indicated that there may have been some  
17 belief that they were covered and they were  
18 planning at some time to implement some of  
19 those OSHA process safety management but they  
20 had not at the time of the incident.

21 MS. PADRICK: Thank you.

22 CHAIRMAN BRESLAND: Thank you.

1                   MR. WHEELER: My name is Wess  
2 Wheeler. And one of the questions that I  
3 have, Mr. Bresland, is as a requirement of  
4 back up systems, the emphasis and  
5 recommendations from the CSB actually say  
6 that, you know, we want to deal with  
7 education, which I agree with wholeheartedly.  
8 But one of the other things that can come from  
9 this board is a recommendation to OSHA or to  
10 process safety management systems to have a  
11 required documentation of at least a back up  
12 system in place, operational and checked out  
13 prior to any of these pilot plants actually  
14 going into production.

15                   What kind of processes or what  
16 kind of recommendations can be made in that  
17 endeavor?

18                   CHAIRMAN BRESLAND: Let me turn  
19 that over to Mr. Hall and I can get back to it  
20 as well and maybe some of the board members  
21 would like to comment on that.

22                   MR. HALL: As I mentioned in the

1 presentation, the CSB has investigated a  
2 number of reactive chemical incidents over the  
3 years since our formation and since we began  
4 investigating incidents in 1998 and have made  
5 a large number of regulatory and industry  
6 recommendations with regard to that.

7           The back up systems are covered as  
8 part of standard design practice, it's  
9 something OSHA refers to as generally accepted  
10 engineering practice. So they really do come  
11 into the regulations in that regard because  
12 there are standards and guidelines out there  
13 that address how to design the system and  
14 they're included in those guidelines and OSHA  
15 incorporates those within their regulations.

16           CHAIRMAN BRESLAND: Back almost  
17 seven years to the day, I think it was on  
18 September 17th, 2002, we did make a  
19 recommendation to OSHA on the issue of  
20 reactive chemicals and that's still an open  
21 recommendation. It's a complex  
22 recommendation.

1           But if a facility like this,  
2 regardless of whether it's covered under  
3 reactive chemical or under the facts that it  
4 has flammable solvents, there would be a  
5 standard list of activities that they would be  
6 required to comply with. And one of them  
7 would be looking at doing a process hazard  
8 analysis which is what we talked about  
9 earlier.

10           And in that process analysis I  
11 would hope that they would look at the process  
12 and decide maybe a single source of emergency  
13 cooling, a single source of cooling water is  
14 not appropriate and they would need a back up  
15 source of cooling water that would be  
16 controlled separately from the controlled  
17 system. It would be what we call a hard wired  
18 system which would automatically come on  
19 immediately.

20           I know I struggle with this whole  
21 issue of why did this accident happen. Why  
22 did the company not do the appropriate testing



1 to determine what are the hazards associated  
2 with this? Because when we did the testing we  
3 were able to find quite quickly that there  
4 certainly was a hazard when you got to a  
5 certain temperature in the reaction.

6 MR. WHEELER: I agree that the  
7 back up system in place might have helped  
8 prevent this and prevent the loss of  
9 businesses and the loss of life that we  
10 actually had. And that was one of the things  
11 that I would have liked to have seen come out  
12 of this, some way we could document that the  
13 back up system is in place like you said hard  
14 wired and separate from the automation so that  
15 we have that in place before these  
16 entrepreneurs actually go out and venture into  
17 this realm of an unknown uncertainty.

18 Thank you very much.

19 CHAIRMAN BRESLAND: It's certainly  
20 not unusual to have a back up system, a back  
21 up shut down system, a back up emergency  
22 system that is hard wired separate from the

1 distributive control system that operates the  
2 process. I'm not talking about this process  
3 but just in the chemical and refining industry  
4 in general. That there's a particular hazard  
5 that's a particularly dangerous hazard, that  
6 would be a common practice that would be put  
7 in place.

8 MR. WHEELER: Thank you.

9 CHAIRMAN BRESLAND: One more  
10 gentleman coming up.

11 MR. McMASTER: Jim McMaster. And  
12 I have a question.

13 You mentioned that a company,  
14 Afton, produces the same product.

15 Have they been investigated or  
16 looked over to see if they have in place the  
17 needed safety measures to continue operation  
18 so this doesn't happen again?

19 CHAIRMAN BRESLAND: Mr. Hall.

20 MR. HALL: The CSB did not conduct  
21 an investigation of Afton. Afton is, though,  
22 a large chemical company that's been operating

1 for many years and we, you know, look to see  
2 from our data, from the public domain if there  
3 had ever been any accidents with this material  
4 and detected no accidents with this material.  
5 Our particular charter to investigate here  
6 really didn't allow us to go investigate  
7 Afton's activities after the fact.

8 MR. McMASTER: All right. Thank  
9 you.

10 CHAIRMAN BRESLAND: In your  
11 conversations with Afton, Mr. Hall, were they  
12 aware of the second exotherm that we  
13 discovered in our testing?

14 MR. HALL: We did have several  
15 conversations with Afton and they were fully  
16 aware of the behavior of this material.

17 CHAIRMAN BRESLAND: Thank you.

18 Any more people who'd like to come  
19 up and make a comment or ask a question?

20 MR. ROGERS: Good evening. My  
21 name is Aaron Rogers. You've referred to  
22 Afton several times here.

1           So if they were aware of the  
2 second exothermic reaction, had they conducted  
3 a process hazard analysis?

4           MR. BRESLAND: Mr. Hall.

5           MR. HALL: Because we didn't  
6 investigate Afton I really don't know the  
7 answer to that question.

8           MR. ROGERS: Thank you.

9           CHAIRMAN BRESLAND: Do we have  
10 anyone else who would like --

11          MR. SCOPPA: My name is Rick  
12 Scoppa, S-C-O-P-P-A.

13          You mentioned that there's one  
14 other company that makes this material and  
15 that this company started making it and it's  
16 an extremely hazardous material. I don't  
17 understand how they could get started to make  
18 this without one of the regulatory agencies  
19 being heavily involved with making sure that  
20 they did do the testing necessary to ensure  
21 their process system was accurate or proper.

22          CHAIRMAN BRESLAND: Are you

1 referring to Afton or are you referring to T2?

2 MR. SCOPPA: T2.

3 CHAIRMAN BRESLAND: Okay.

4 MR. SCOPPA: With it being an

5 extremely hazardous material, I don't

6 understand how a company can get started

7 without at least the fire department knowing

8 they were making it so they could have had

9 some response drills prior to the incident.

10 CHAIRMAN BRESLAND: Well, I see

11 there are some members of the fire department

12 here this evening and I'm not going to put

13 them on the spot. But I know that there are

14 requirements not connected to the actual

15 design construction operation of the facility.

16 But there are requirements that companies

17 report to the fire department and to the local

18 emergency planning committee the chemicals

19 that they have on site so that the appropriate

20 emergency response procedures and planning can

21 be put in place.

22 I think my understanding is, I'm

1 going to ask Mr. Hall this question, was that  
2 there was a partial reporting but not a  
3 complete reporting of the chemicals that were  
4 on site at that location. And let me ask Mr.  
5 Hall to expand on that.

6 MR. HALL: In the investigation we  
7 found there's a particular regulation which  
8 requires reporting of materials under a tier  
9 two report to the local emergency planning  
10 commission, the fire department and the like.

11 They submitted a report under this  
12 particular regulation, it's an EPA regulation,  
13 that reported the various solvents and the raw  
14 materials and the sodium that they had on  
15 site. What they failed to include in this  
16 particular report was the actual  
17 methylcyclopentadiene and diethylene glycol  
18 which is an extremely hazardous substance and  
19 it was not included in the report that was  
20 sent to the LAPC and the fire department.

21 The fire department was aware of  
22 the solvents that were on the site and did

1 inspections. They were aware of the sodium  
2 that was on site and did inspections. And I  
3 believe they actually did drills dealing with  
4 a sodium mishap on site. But they were never  
5 informed of the MCMT production that was going  
6 on at the site. The fire department was there  
7 and looked at the hazards they were told  
8 about.

9 CHAIRMAN BRESLAND: Thank you.

10 Do we have anyone else who would  
11 like to make a comment or ask question? Okay.

12 We'll move on to the next phase of  
13 the meeting which is when we take a vote on  
14 the report and the recommendations.

15 And I'd like to ask if one of the  
16 board members would like to make a motion?

17 MR. WARK: Yes, Mr. Chairman, I'd  
18 like to make a motion. I'd like to move that  
19 the board approve the CSB investigative report  
20 and recommendations No. 2008-03-I-FL regarding  
21 the agency's investigation into the explosion  
22 and chemical fire that occurred on December

1 19, 2007 at the T2 Laboratories, Incorporated  
2 in Jacksonville, Florida.

3 CHAIRMAN BRESLAND: Thank you  
4 Board Member Wark.

5 Do we have a seconder?

6 MR. WRIGHT: I second, Mr.  
7 Chairman.

8 CHAIRMAN BRESLAND: I'd like to  
9 restate the motion. And the motion is to  
10 approve the CSB investigative report and  
11 Recommendation No. 2008 dash 03 dash 1 dash  
12 Florida, regarding the agency's investigation  
13 into the explosion and chemical fire that  
14 occurred on December 19th, 2007 at the T2  
15 Laboratories, Incorporated in Jacksonville,  
16 Florida.

17 Do we have any discussion on this  
18 motion from the board members?

19 Board Member Wark?

20 MR. WARK: No, I have no  
21 discussion.

22 CHAIRMAN BRESLAND: Board Member



1 Wright?

2 MR. WRIGHT: No.

3 CHAIRMAN BRESLAND: Board Member

4 Visscher?

5 MR. VISSCHER: No.

6 CHAIRMAN BRESLAND: In that case  
7 we'll close the discussion on this motion and  
8 we'll call for a vote and we'll start at the  
9 far end with Board Member Wark. You either  
10 approve or disapprove of the motion.

11 MR. WARK: Approve.

12 CHAIRMAN BRESLAND: Board Member

13 Wright?

14 MR. WRIGHT: Mr. Chairman, I

15 approve.

16 CHAIRMAN BRESLAND: Board Member

17 Visscher?

18 MR. VISSCHER: Approve.

19 CHAIRMAN BRESLAND: And I approve  
20 also board members.

21 Based on that the motion has been  
22 approved and the investigation report and its

1 recommendations have been approved by the  
2 board. Which brings us to some closing  
3 remarks. Just a couple of points I'd like to  
4 make.

5           The members this evening have made  
6 reference to the emergency responders who  
7 responded to this incident. To those of you  
8 who saw the photographs of the incidents, the  
9 dramatic photographs of the fire, some of them  
10 are here this evening. Let me just ask, I see  
11 a lot of firefighters here just a show of  
12 hands of firefighters if you did actually  
13 respond to the incident.

14           (Applause)

15           CHAIRMAN BRESLAND: Any other  
16 emergency responders, EMTs, paramedics? Okay.

17           Well, again thank you very much  
18 for your response under very dangerous  
19 circumstances.

20           I'd also like to point out that  
21 this morning we had a separate meeting with  
22 the family members of some of the people who

1 were either killed or injured in the accident  
2 and also some of -- there were some people  
3 there who actually were at the site on the day  
4 of the explosion and in one case very  
5 seriously injured. We were able to give them  
6 basically the same presentation that we gave  
7 here this evening but in a quieter, more sober  
8 setting. And a lot of them could get an  
9 education what actually happened.

10           For me and for Mr. Hall who was  
11 there, it was a very sobering experience to  
12 meet those people and realize the terrible  
13 tragedy that impacted them and the fact that  
14 they are going to be dealing with this for the  
15 rest of their lives, especially the people who  
16 were very seriously injured.

17           I would like to thank each of the  
18 board members for your participation. My  
19 thanks go to Mr. Hall and his team for their  
20 diligence in carrying out this complex and  
21 difficult investigation. All of us here have  
22 a strong interest in preventing these tragic

1 incidents from occurring.

2 Our goal at the Chemical Safety  
3 Board is to ensure that accidents do not occur  
4 in the future as a result of runaway chemical  
5 reactions, and that future chemical  
6 engineering students will be educated about  
7 the hazards associated with reactive  
8 chemistry.

9 In the next few months the CSB  
10 will be working with the American Institute of  
11 Chemical Engineers and the Accreditation Board  
12 to ensure implementation of the safety  
13 recommendations that were approved here this  
14 evening.

15 Just because we pass a vote and we  
16 make recommendations, it doesn't stop here  
17 this evening. We continue for several years  
18 with follow up on the recommendations to make  
19 sure that to the best of our ability that the  
20 recommendations are complied with and we will  
21 be in communication with AIChE and with the  
22 Accreditation Board to make sure that they do

1 move forward in the way that we would  
2 recommend.

3 I would like to thank all of  
4 today's participants. I'd like to thank the  
5 audience for your attention. I'd like to  
6 thank the people who took the opportunity to  
7 come up and make comments also.

8 And with that this evening's  
9 meeting is adjourned.

10 (Whereupon, the proceedings were  
11 adjourned at 7:30 p.m.)

12

13

14

15

16

17

18

19

20

21

22

<b>A</b>				
<b>Aaron</b> 67:21	<b>adjourned</b> 77:9,11	50:8 64:14,22	<b>awareness</b> 34:6	<b>big</b> 49:13,21 53:3
<b>ABET</b> 33:21 34:6	<b>Adventist</b> 9:9	69:19	47:22 48:7,8	54:7,14 55:1,14
<b>ability</b> 59:22 76:19	<b>aerial</b> 15:5	<b>appropriately</b>	<b>A&amp;M</b> 31:15	<b>blank</b> 58:2
<b>able</b> 7:15 30:16	<b>aerospace</b> 8:21	57:16		<b>blast</b> 5:17,20 11:1
41:9 42:17 43:2	<b>Afton</b> 53:16 66:14	<b>approve</b> 71:19	<b>B</b>	14:2,9 16:16 17:7
43:10,18 44:20	66:21,21 67:11,15	72:10 73:10,11,15	<b>Bachelor</b> 9:19	<b>blaze</b> 18:1
51:21 52:1 65:3	67:22 68:6 69:1	73:18,19	<b>bachelor's</b> 8:16 9:8	<b>blending</b> 12:13
75:5	<b>Afton's</b> 67:7	<b>approved</b> 73:22	10:4	<b>blockage</b> 21:2 29:2
<b>absent</b> 46:8	<b>agencies</b> 18:7 19:11	74:1 76:13	<b>back</b> 4:20 23:6	<b>blow</b> 51:22 52:6
<b>absorption</b> 13:10	41:8,16,17 68:18	<b>approximately</b>	43:11 50:19 55:20	<b>blows</b> 54:10,11
<b>accepted</b> 63:9	<b>agency</b> 3:17 13:12	55:11	55:22 62:4,11,19	<b>board</b> 1:2,17,18,19
<b>access</b> 18:20 29:6	<b>agency's</b> 71:21	<b>area</b> 7:8 15:7,16	63:7,16 64:14	2:17 3:8,10,10 4:8
<b>accident</b> 9:6 20:21	72:12	<b>areas</b> 22:9 57:4	65:7,13,20,20,21	4:16 6:10,11,12
47:8 50:21 61:1	<b>agitation</b> 22:18	<b>ares</b> 22:20	<b>background</b> 12:7	6:16,18 8:4 10:2
64:21 75:1	<b>agitator</b> 20:6	<b>arrived</b> 18:14	48:6	10:14 11:18 12:4
<b>accidents</b> 3:18,21	<b>agree</b> 62:7 65:6	35:18	<b>balances</b> 50:4	33:20 34:18 40:10
4:5 7:3 33:8,12	<b>AICHe</b> 32:7,12	<b>asking</b> 58:3,21	<b>based</b> 6:22 22:7	40:19 41:3 50:11
67:3,4 76:3	34:11,13 76:21	<b>aspect</b> 50:4	23:4 47:10 73:21	56:16,17 57:21
<b>accounts</b> 35:7	<b>aimed</b> 33:11	<b>aspects</b> 3:21 46:3	<b>basically</b> 39:18	62:9,20 71:16,19
<b>Accreditation</b>	<b>air</b> 14:13 17:21	<b>assessed</b> 17:17	75:6	72:4,18,19,22
33:18,20 76:11,22	<b>Airport</b> 17:22	<b>assessment</b> 48:16	<b>batch</b> 13:16 23:17	73:3,9,12,16,20
<b>accredited</b> 34:8	<b>allow</b> 4:7 6:7 67:6	48:18	30:6,13,16 40:3	74:2 75:18 76:3
<b>accurate</b> 68:21	<b>allowed</b> 27:20	<b>assist</b> 18:4	42:13	76:11,22
<b>achieve</b> 38:5 46:4	42:16	<b>associated</b> 32:19	<b>batches</b> 13:1,14	<b>board's</b> 7:1
<b>acidic</b> 59:4	<b>allowing</b> 29:20	35:19 65:1 76:7	19:22 30:9,19	<b>boil</b> 27:20,21 29:20
<b>action</b> 57:15	<b>allows</b> 55:4	<b>assume</b> 52:16	39:22 43:13,13	55:7
<b>actions</b> 29:10	<b>American</b> 18:3	<b>Assuming</b> 54:6	51:14,16	<b>boiled</b> 20:18 28:2
<b>activated</b> 29:17	32:6 34:5 76:10	<b>assumption</b> 38:13	<b>battle</b> 18:10	<b>boiling</b> 55:7
<b>activities</b> 18:22	<b>amount</b> 26:6	<b>assure</b> 33:19	<b>battling</b> 11:9	<b>boils</b> 59:2
64:5 67:7	<b>analysis</b> 36:9 38:16	<b>atmosphere</b> 20:8	<b>began</b> 6:1 12:12,14	<b>booster</b> 13:4
<b>activity</b> 18:16	38:19 39:1,5,11	<b>attach</b> 29:5	12:20 13:16,20	<b>bottom</b> 26:22 27:19
25:10 51:18	57:1 60:14 64:8	<b>attention</b> 77:5	18:15 21:4,17	<b>break</b> 36:22
<b>actual</b> 38:5 69:14	64:10 68:3	<b>audience</b> 6:5 7:5,17	32:8 39:17 40:3	<b>Bresland</b> 1:16 3:3,9
70:16	<b>analyzing</b> 11:15	58:5 77:5	63:3	8:7,9,11 9:4 10:13
<b>add</b> 34:6	<b>animated</b> 19:20	<b>audio/visual</b> 60:5	<b>beginning</b> 50:20	34:16,19 37:9
<b>additional</b> 7:11	<b>animation</b> 19:17	<b>automatic</b> 56:7	51:1	40:10 50:11 52:13
29:6	21:22	<b>automatically</b>	<b>begins</b> 25:20	53:12,19 54:2
<b>Additionally</b> 29:14	<b>anomalies</b> 30:11	64:18	<b>behaves</b> 44:16	55:15 56:14 57:18
31:4	<b>answer</b> 68:7	<b>automation</b> 65:14	<b>behavior</b> 67:16	58:15,21 59:6
<b>additive</b> 19:22	<b>answers</b> 49:16	<b>automotive</b> 13:6	<b>belief</b> 61:17	60:3,16,20 61:22
<b>address</b> 23:13	<b>anybody</b> 38:18	<b>available</b> 29:4 36:3	<b>believe</b> 7:20 39:8	62:3,18 63:16
31:10,13 32:12	<b>Apart</b> 46:7	45:9,15	39:13 71:3	65:19 66:9,19
46:2 63:13	<b>apparatus</b> 26:7,10	<b>avoid</b> 54:16	<b>belonging</b> 16:17	67:10,17 68:4,9
<b>addressing</b> 33:14	<b>appendix</b> 45:22	<b>avoids</b> 54:11	<b>bent</b> 27:3	68:22 69:3,10
<b>adjacent</b> 17:6	<b>Applause</b> 74:14	<b>aware</b> 42:1,6 56:21	<b>best</b> 76:19	71:9 72:3,8,22
<b>Adjourn</b> 2:21	<b>applied</b> 28:14	57:1,13 67:12,16	<b>better</b> 47:22	73:3,6,12,16,19
	<b>appropriate</b> 7:9	68:1 70:21 71:1	<b>beyond</b> 51:17	74:15

<b>brief</b> 12:7	44:15	47:14,21 48:9,12	67:19 71:11	<b>conducted</b> 18:21
<b>bring</b> 43:18	<b>center</b> 14:8 15:7	48:12,13 49:13	<b>comments</b> 4:13	18:22 29:22 31:18
<b>brings</b> 74:2	28:5 31:15,18	53:3,13 63:2 64:3	7:12,13,18 77:7	68:2
<b>broke</b> 37:2	<b>CEO</b> 3:10	66:3,22 71:22	<b>commercially</b> 53:2	<b>connected</b> 69:14
<b>build</b> 29:2	<b>certain</b> 65:5	72:13 76:2,4,5,11	53:6	<b>consider</b> 29:13
<b>building</b> 14:18 16:1	<b>certainly</b> 7:10 65:4	<b>chemicals</b> 20:4	<b>commission</b> 70:10	<b>considered</b> 59:18
17:1,4 27:4	65:19	23:7 29:20,21	<b>committee</b> 69:18	<b>consists</b> 32:11
<b>buildings</b> 5:21	<b>certificate</b> 32:8,10	31:7 40:5 46:1	<b>common</b> 66:6	<b>construction</b> 69:15
11:10 16:17	34:9	55:6,8,9 61:6,6	<b>commonly</b> 22:19	<b>consultants</b> 39:3
<b>built</b> 12:19	<b>certificates</b> 32:9	63:20 69:18 70:3	36:3	<b>contained</b> 15:17
<b>burn</b> 15:19	<b>Certified</b> 10:2,12	<b>chemist</b> 31:5	<b>communication</b>	<b>contents</b> 2:10 14:2
<b>burst</b> 14:1 26:18	<b>chairman</b> 1:16 3:3	<b>chemistry</b> 22:9,11	76:21	33:5
28:10 44:20	3:9 8:7,9,11 10:13	26:5 30:2,22 31:3	<b>community</b> 11:4,14	<b>continue</b> 20:13
<b>bursting</b> 21:15	34:19 35:4 37:8,9	31:8,9 47:17 49:2	11:19 16:4 35:10	25:4 66:17 76:17
33:4	37:11 40:10,13	76:8	36:13 40:15 41:10	<b>continued</b> 15:19
<b>business</b> 12:10	47:19 48:5 50:10	<b>Chief</b> 10:14	<b>companies</b> 13:8	30:17
14:17,21 17:3	50:11 52:13 53:12	<b>chosen</b> 54:22	19:10 49:3,6,13	<b>contrast</b> 26:13
<b>businesses</b> 11:7,9	53:19 54:2 55:15	<b>Chris</b> 1:22 3:13	49:15 53:3 69:16	<b>contributing</b> 32:16
16:13,18 19:2	56:14,19 57:18	<b>circumstances</b>	<b>company</b> 12:13	32:20
57:5 65:9	58:15 59:6 60:3	74:19	13:8 17:6,8 42:1	<b>control</b> 15:21 18:8
<b>C</b>	60:16,20 61:22	<b>City</b> 17:14 27:19	45:19 48:22 53:15	20:3 21:10 27:15
<b>call</b> 7:9 64:17 73:8	62:18 63:16 65:19	58:20	57:12 64:22 66:13	30:7,16 43:2
<b>called</b> 12:15 21:7	66:9,19 67:10,17	<b>clarification</b> 7:22	66:22 68:14,15	55:19 56:8 66:1
45:19 53:15,16	68:9,22 69:3,10	<b>clean</b> 11:11 18:4	69:6	<b>controlled</b> 20:1
<b>camera</b> 14:6	71:9,17 72:3,7,8	<b>clinical</b> 9:10	<b>compare</b> 48:7	24:16 56:8 64:16
<b>capability</b> 52:16	72:22 73:3,6,12	<b>clip</b> 14:5	<b>complete</b> 6:10 70:3	64:16
<b>carefully</b> 59:10	73:14,16,19 74:15	<b>close</b> 73:7	<b>complex</b> 63:21	<b>controlling</b> 20:18
<b>carrying</b> 75:20	<b>Challenger</b> 52:4	<b>closed</b> 28:8 38:4,8	75:20	<b>conversations</b>
<b>case</b> 4:22 41:13	<b>changing</b> 55:16	<b>closely</b> 44:16	<b>compliance</b> 9:13	67:11,15
42:17 43:17 48:20	<b>chapter</b> 34:12	<b>closing</b> 74:2	<b>complied</b> 76:20	<b>cool</b> 20:22 30:4
50:8 57:15 73:6	<b>chapters</b> 32:13	<b>clues</b> 52:12	<b>comply</b> 64:6	60:1
75:4	<b>charge</b> 9:1	<b>collected</b> 19:3	<b>components</b> 54:20	<b>cooling</b> 13:19 14:7
<b>cases</b> 48:21	<b>charter</b> 67:5	<b>collection</b> 22:7	<b>comprehensive</b>	20:17,22 21:8
<b>catalogued</b> 19:6	<b>checked</b> 62:12	<b>columns</b> 15:13	33:8	22:12 24:2,16
<b>catastrophic</b> 54:12	<b>checks</b> 50:3	<b>combined</b> 46:1	<b>computer</b> 11:21	25:1 27:16,17,18
54:16 57:2	<b>check-in</b> 7:8	<b>come</b> 62:8 63:10	<b>computerized</b> 20:2	28:3,14,15,18,20
<b>catch</b> 51:22	<b>chemical</b> 1:1 3:8,18	64:18 65:11 67:18	<b>concern</b> 43:16	32:21 43:2,19,20
<b>caught</b> 52:7,8	3:21 8:21 10:4,10	77:7	<b>Concerned</b> 21:10	55:17,18,19 56:6
<b>cause</b> 28:21 30:11	11:9 12:10,15,19	<b>comes</b> 47:4	<b>conclude</b> 4:15	59:17,19 64:13,13
32:17 43:15	13:14 18:10 19:14	<b>coming</b> 60:4 66:10	<b>concludes</b> 57:20	64:15
<b>caused</b> 11:3 16:13	21:5 22:15,19	<b>command</b> 40:15	<b>concrete</b> 16:1	<b>cooperated</b> 18:8
24:5	23:2,5 24:5,7	41:7	<b>condemned</b> 16:19	<b>copy</b> 57:22
<b>causes</b> 3:22 10:17	30:20 31:5,11,17	<b>commend</b> 35:6,9	17:2,20	<b>core</b> 36:10
22:21 32:16,21	31:19 32:6 33:7,9	37:12	<b>condition</b> 23:10	<b>Corporation</b> 53:17
<b>causing</b> 59:18	33:12,15,16 34:1	<b>commending</b> 40:14	<b>conditions</b> 25:5	<b>correct</b> 39:16 42:8
<b>cell</b> 5:2,4 38:4,5,8	34:3,5,7 36:19,22	<b>comment</b> 7:6,20	<b>conduct</b> 38:15	45:5 57:6 59:1
	36:22 37:4 38:20	12:4 58:6 62:21	60:14 66:20	<b>corrected</b> 25:5

**Counsel** 1:22 3:13  
10:14  
**country** 36:8 41:19  
53:6,9,13  
**couple** 35:5 74:3  
**course** 60:13  
**cover** 31:12  
**coverage** 61:14  
**covered** 60:17 61:2  
61:2,6,13,17 63:7  
64:2  
**co-owners** 21:6  
**criteria** 34:2  
**Cross** 18:3  
**CSB** 3:9,14,16 4:7  
5:17 6:1 9:12,21  
11:1,14 18:13  
19:9,13,18 20:21  
29:11 33:6 53:7  
62:5 63:1 66:20  
71:19 72:10 76:9  
**curious** 60:10  
**currently** 9:9  
**curricula** 34:7  
**curriculum** 31:21  
34:2

---

### D

---

**damage** 11:4 16:2,3  
16:19 17:14,19  
57:4  
**damaged** 5:20  
11:10 14:19 19:7  
27:3  
**danger** 37:3  
**dangerous** 40:8  
66:5 74:18  
**dash** 72:11,11,11  
**data** 51:10 67:2  
**dating** 23:6  
**day** 15:6 17:9 20:20  
24:8 28:12 33:1  
40:2 44:21 63:17  
75:3  
**deal** 57:17 62:6  
**dealing** 50:3 71:3  
75:14

**deals** 39:8  
**debris** 5:19 11:4  
15:1 16:20  
**December** 4:10 5:5  
10:20 13:15 18:14  
19:16 71:22 72:14  
**decide** 46:18 64:12  
**decided** 18:13  
**dedicated** 56:7  
**deepest** 6:8  
**degree** 8:16,17 9:8  
9:19 10:4 33:22  
**degrees** 20:10,15  
24:18,19 25:20  
26:2  
**delayed** 35:12  
**demolished** 11:10  
**department** 17:15  
17:19 18:1,2  
41:11 69:7,11,17  
70:10,20,21 71:6  
**deploy** 18:13  
**deployment** 41:4  
**deployments** 41:14  
**deposit** 59:2  
**descaled** 58:13,14  
58:17  
**descaling** 59:21  
**describe** 23:10  
**described** 23:7  
**design** 3:22 8:19  
22:13 31:10,12  
50:1 51:11,12  
63:8,13 69:15  
**designation** 10:1  
**designed** 4:4 12:19  
29:12,13 32:7  
54:7  
**designing** 22:14  
31:2 51:2  
**desirable** 51:19  
**desired** 25:16  
51:17  
**destroyed** 5:6 17:7  
22:1 43:9,10  
**destruction** 54:16  
**detail** 22:22 46:1

**detailed** 39:2  
**detect** 36:5  
**detected** 42:11 67:4  
**determination**  
61:14  
**determine** 19:8  
30:11 36:9 44:2  
61:1,12 65:1  
**determined** 22:5  
32:16 61:9  
**determining** 25:10  
**devastating** 16:3  
**devastation** 6:4  
**developed** 31:16  
45:18  
**developing** 31:1  
49:1 51:1,1  
**development** 12:14  
17:19 25:9 45:17  
**developmental**  
39:19 42:10 51:7  
**deviation** 52:2,5  
**device** 39:18 44:14  
44:17 55:10,14  
**dictation** 58:10  
**diethylene** 24:10  
70:17  
**different** 23:7 41:8  
41:15  
**difficult** 75:21  
**difficulty** 18:18  
**diglyme** 24:11  
25:15  
**diligence** 75:20  
**diligent** 8:2 34:21  
**dimethyl** 24:11  
**direct** 6:16  
**directed** 7:18  
**direction** 15:12  
48:14  
**directions** 11:5  
15:15 16:21  
**directly** 7:16  
**disapprove** 73:10  
**discovered** 42:13  
67:13  
**discuss** 12:6 55:17

**discussed** 27:13  
**discussion** 4:15  
72:17,21 73:7  
**disk** 21:15 28:10  
46:19 54:8,9,15  
**dismissed** 17:9  
**dissipates** 14:10  
**distribution** 13:8  
**distributive** 66:1  
**disturbed** 5:3  
**Division** 17:17  
**doctoral** 9:10  
**document** 19:10  
65:12  
**documentation**  
43:7,9,10,12 47:3  
62:11  
**documents** 19:12  
**doing** 48:10 52:17  
64:7  
**domain** 67:2  
**domestic** 53:15  
**DOT** 9:15  
**downtown** 5:18  
11:2  
**dozens** 11:8 19:9  
**draft** 6:13  
**drain** 29:1  
**dramatic** 74:9  
**drills** 69:9 71:3  
**drop** 55:3  
**due** 18:12 21:1  
30:14  
**duplicate** 44:20  
56:12  
**duplicated** 19:15

---

### E

---

**earlier** 47:1 64:9  
**early** 30:18  
**Ecotane** 13:3  
**educated** 76:6  
**education** 31:8  
32:5 33:17 47:21  
47:21 48:3,12,13  
49:17,22 62:7  
75:9

**educational** 33:20  
**effective** 6:21  
**efforts** 3:14  
**eight** 14:19  
**either** 24:11 58:5  
73:9 75:1  
**emergency** 4:22  
18:4,6 26:19 28:6  
28:10 29:4,12,15  
36:13 40:14,20,22  
41:6,10 55:18  
64:12 65:21 69:18  
69:20 70:9 74:6  
74:16  
**emphasis** 49:21  
62:4  
**emphasize** 7:3  
**employee** 16:9  
**employees** 5:12  
11:5,6 12:22  
14:19 15:22 16:6  
17:8 19:1 21:11  
56:3 61:15  
**EMTs** 74:16  
**encourages** 34:14  
**endeavor** 62:17  
**energetic** 14:4  
24:22 26:6 59:14  
**energy** 40:7  
**engine** 21:16  
**engineer** 8:16  
10:12 31:5  
**engineering** 8:17  
8:18 10:5 31:11  
31:19 33:16,21,22  
34:1,3,7 48:6,8,9  
48:13,15 63:10  
76:6  
**engineers** 22:20  
32:7 34:5 76:11  
**ensure** 68:20 76:3  
76:12  
**enter** 18:16  
**entered** 18:10  
**entering** 36:14  
**entertain** 34:17  
**entire** 28:21



<b>entrepreneurial</b> 48:22 49:3	<b>exist</b> 46:11	69:5 70:18	22:5	15:13 19:3 20:21
<b>entrepreneurs</b> 65:16	<b>existed</b> 49:5	<b>eyewitnesses</b> 19:1	<b>fire</b> 1:4 4:10 5:12	23:5 24:13 28:18
<b>entry</b> 35:17	<b>exits</b> 4:19,20		10:18 11:9 17:13	29:11 31:20 36:2
<b>environment</b> 49:8	<b>exotherm</b> 23:14	<b>F</b>	17:14,22 18:10	53:21 57:11 70:7
<b>environmental</b> 11:11 13:11 17:16	24:15,22 42:14,14	<b>facilitated</b> 3:15	21:11 35:9 36:13	<b>four</b> 5:12,13 6:12
17:18 18:2	42:19 67:12	<b>facilities</b> 3:19 57:3	41:11 69:7,11,17	11:5 16:5 32:11
<b>EPA</b> 9:14 35:21	<b>exothermic</b> 20:12	<b>facility</b> 5:7,22	70:10,20,21 71:6	50:18
70:12	22:10,10,15 25:10	12:11 15:16 22:2	71:22 72:13 74:9	<b>four-inch</b> 28:6
<b>equipment</b> 3:22	27:14 29:17 30:3	64:1 69:15	<b>firefighters</b> 11:8	<b>fragments</b> 19:3
44:9	30:8 31:2 37:20	<b>fact</b> 40:16 61:15	18:9 74:11,12	<b>free</b> 32:10,14 34:11
<b>equivalent</b> 14:2	42:2,5 43:14	67:7 75:13	<b>fires</b> 18:8	<b>frequent</b> 43:6
21:20	44:11 45:11 47:16	<b>facts</b> 10:17 64:3	<b>first</b> 14:5 20:3 22:9	<b>friends</b> 6:6
<b>especially</b> 75:15	47:17 51:9,18	<b>Fahrenheit</b> 24:19	22:22 23:15,15,19	<b>full</b> 19:18 23:12
<b>established</b> 30:18	68:2	<b>fail</b> 28:21	24:7,14 25:2,16	39:12
<b>estimates</b> 54:14	<b>exotherms</b> 42:12	<b>failed</b> 25:2 33:1	26:14 30:3,5,5,9	<b>fully</b> 30:16 43:15
<b>Ethol</b> 45:19	<b>expand</b> 70:5	52:5 70:15	30:15 35:10 39:22	50:2 67:15
<b>Ethyl</b> 53:16	<b>experience</b> 8:19	<b>failure</b> 21:3 28:19	42:1,3,3,5,12,14	<b>full-scale</b> 30:6
<b>evaluate</b> 44:11	30:21 31:1 55:22	28:22 29:7 32:22	43:13,14 47:15	44:16
51:20 53:11	75:11	59:19	48:3 51:14,16	<b>furniture</b> 16:15
<b>evaluated</b> 35:19	<b>experiment</b> 37:16	<b>failures</b> 59:16,18	60:21 61:1	<b>further</b> 18:9 33:14
<b>evaluation</b> 8:20	<b>expertise</b> 9:14	<b>fair</b> 48:16,17	<b>five</b> 16:17 18:17	<b>future</b> 4:5 7:4
44:13 51:8	52:19	<b>fairly</b> 43:5	36:11	11:16 56:22 57:8
<b>evening</b> 3:7 4:14	<b>experts</b> 54:14	<b>fall</b> 14:13	<b>fixed</b> 3:18	76:4,5
5:11 6:3,12,21	<b>explain</b> 6:9	<b>family</b> 6:6 74:22	<b>flammability</b> 61:5	
10:15 34:22 67:20	<b>exploded</b> 14:2 54:3	<b>far</b> 9:7 73:9	61:7,10	<b>G</b>
69:12 74:5,10	<b>exploding</b> 33:5	<b>Fahrenheit</b> 20:10	<b>flammable</b> 15:18	<b>gallon</b> 20:1
75:7 76:14,17	<b>explosion</b> 1:4 4:10	25:19,20 26:2	64:4	<b>gallons</b> 15:17
<b>evening's</b> 3:15 4:6	5:6,11,19 10:18	<b>farm</b> 15:17	<b>flew</b> 16:20	<b>Gary</b> 1:17 3:11
77:8	11:3 14:4,15	<b>faulty</b> 29:3	<b>flinging</b> 11:4	<b>gas</b> 21:17
<b>event</b> 18:9 29:7	15:18 16:5 17:13	<b>Faye</b> 12:20 15:14	<b>floor</b> 4:13	<b>gasoline</b> 13:5 19:22
<b>events</b> 57:2	19:9 21:19,22	16:18	<b>Florida</b> 1:7,8 4:11	<b>gasses</b> 24:17
<b>eventually</b> 52:7	24:6 28:17 37:17	<b>federal</b> 3:17 41:16	18:2 72:2,12,16	<b>gather</b> 41:22
<b>everybody</b> 3:5	50:17 54:5,12	<b>feed</b> 56:13	<b>flow</b> 30:13	<b>gavel</b> 3:6
<b>evidence</b> 22:7	59:11,11,15 71:21	<b>feet</b> 14:9,16,18,22	<b>focus</b> 47:20 48:3	<b>gear</b> 36:14
38:18 39:1 47:4	72:13 75:4	15:12,14 16:1,7	<b>focusing</b> 47:15	<b>general</b> 1:22 3:13
59:8	<b>explosions</b> 5:16	27:4,11,12	<b>follow</b> 50:14 56:19	50:16 66:4
<b>examined</b> 19:2,6	10:22	<b>felt</b> 5:18 11:2 59:12	76:18	<b>generally</b> 63:9
<b>examines</b> 3:20	<b>explosive</b> 38:19	<b>field</b> 36:5	<b>followed</b> 39:6	<b>generate</b> 27:14
<b>example</b> 40:21	<b>exposure</b> 36:21	<b>fight</b> 18:1,10	<b>following</b> 4:12 12:2	<b>generating</b> 24:15
52:20	37:3	<b>fill</b> 20:16	22:2 60:22	<b>gentleman</b> 58:7
<b>excellent</b> 18:7	<b>exposures</b> 36:19	<b>final</b> 4:9,16 23:8	<b>follows</b> 6:10	66:10
34:21	<b>extend</b> 6:8	39:7	<b>food</b> 10:10	<b>gentlemen</b> 10:14
<b>excursions</b> 43:14	<b>extensive</b> 16:5,11	<b>Finally</b> 19:13	<b>footage</b> 14:3	<b>George</b> 9:11 58:11
<b>exhibits</b> 24:14,21	17:13 45:16 60:22	<b>find</b> 38:17,22 39:2	<b>formation</b> 63:3	<b>getting</b> 35:13 46:4
	<b>exterior</b> 27:18	42:9 61:11 65:3	<b>formula</b> 46:20	<b>give</b> 5:3 12:7 46:5
	<b>extremely</b> 13:12	<b>findings</b> 4:8 7:1	<b>forward</b> 77:1	75:5
	27:17 35:22 68:16	10:17 11:18 12:2	<b>found</b> 5:20 15:11	<b>glass</b> 15:3 16:15

**glycol** 24:10 70:17  
**go** 36:6 41:20 49:22  
 50:19 65:16 67:6  
 75:19  
**goal** 7:1 76:2  
**goes** 41:14  
**going** 3:5 48:22  
 51:19 62:14 69:12  
 70:1 71:5 75:14  
**good** 3:6 10:15  
 40:21 67:20  
**gotten** 42:22 43:1  
**gradually** 25:17  
**graduate** 9:18 10:1  
**grams** 24:12 44:19  
**graph** 25:13  
**great** 43:16  
**guess** 44:4 50:14  
**guide** 53:10  
**guidelines** 63:12,14

---

**H**


---

**half** 23:16 25:18  
 26:7  
**Hall** 8:13,15,22 9:2  
 9:3 21:21 23:3  
 27:5,6 34:20  
 35:18 36:20 37:15  
 38:2,11,22 39:16  
 40:13 42:8 43:1,7  
 43:20 45:5,14  
 47:2 51:6 52:22  
 53:14,21 54:18  
 56:2,19 57:9,11  
 59:7,8 60:20,21  
 62:19,22 66:19,20  
 67:11,14 68:4,5  
 70:1,5,6 75:10,19  
**handled** 41:12  
**hands** 74:12  
**happen** 42:4 55:5  
 64:21 66:18  
**happened** 42:21  
 49:9 75:9  
**happening** 50:22  
 51:5  
**hard** 59:21 64:17

65:13,22  
**harm** 18:9  
**hazard** 1:2 22:13  
 32:1,19 33:15  
 34:6,10 38:15,18  
 39:1,4 44:12 49:5  
 51:8 57:1,15  
 60:14 64:7 65:4  
 66:4,5 68:3  
**hazardous** 8:20  
 9:15,15 13:12  
 35:14,22 48:1  
 49:1 68:16 69:5  
 70:18  
**hazards** 22:11,17  
 22:18 31:7 32:6  
 32:12 35:19 38:14  
 44:2,3,7,11 45:8  
 45:10 46:3,12,15  
 48:1 50:2 57:12  
 57:13 65:1 71:7  
 76:7

**health** 9:20,22  
**hear** 6:14  
**heard** 21:16  
**heat** 14:9 20:12,18  
 22:10 23:14 24:1  
 24:3,15 27:20  
 29:20 38:6 44:14  
 55:8  
**heated** 20:5  
**heating** 20:11  
 23:20,22  
**heavily** 68:19  
**heeded** 56:22  
**held** 26:13 27:9  
 40:21  
**help** 7:2  
**helped** 9:6 18:1  
 65:7  
**high** 14:9,16 21:17  
 27:11,14 29:16  
 30:15 42:16  
**higher** 24:19  
**highlight** 46:15  
**highly** 13:9 18:18  
 36:16 49:1

**history** 30:12  
**holds** 9:7,22  
**hooked** 56:4,5  
**hope** 11:16 57:7  
 64:11  
**hopefully** 57:3  
**hoses** 29:5  
**hospitalization**  
 16:11  
**hot** 24:16  
**Hotel** 1:8  
**hours** 11:9 15:20  
 23:16 25:18  
**huge** 17:13  
**hydrogen** 20:7  
 47:11  
**hypothesized** 24:4

---

**I**


---

**identified** 22:8 30:5  
**ignited** 15:19  
**Illinois** 10:6  
**illustrates** 25:13  
**immediate** 7:21  
 36:4  
**immediately** 6:1  
 29:4 55:7 64:19  
**impact** 11:13 16:4  
 17:18 18:12  
**impacted** 27:2  
 75:13  
**impacts** 38:19  
**implement** 61:18  
**implementation**  
 76:12  
**implemented** 32:7  
**importance** 22:14  
 40:6  
**important** 27:17  
 40:18 41:5  
**impressed** 41:7  
**improving** 47:21  
**inadequacies** 4:1  
**incapable** 25:10  
 33:2  
**inch** 21:15 26:4,16  
 26:18 28:9

**incidences** 53:20  
**incident** 5:15 6:5,7  
 10:21 11:13,16,21  
 12:6,21 13:2 15:6  
 17:16 18:7,13  
 22:3,21 23:17  
 24:8 27:9 28:12  
 29:7 32:17 33:1  
 35:9 37:13 39:15  
 39:21 40:3,15  
 41:1,7 43:3 44:21  
 52:4 61:20 69:9  
 74:7,13  
**incidents** 33:9  
 40:20 42:21 43:5  
 49:18 53:22 63:2  
 63:4 74:8 76:1  
**include** 70:15  
**included** 5:16  
 10:22 24:9 28:22  
 33:10 63:14 70:19  
**includes** 11:20  
 34:10  
**including** 3:21 34:1  
**inclusion** 32:1  
**Incorporated** 72:1  
 72:15  
**incorporates** 63:15  
**increased** 14:1 32:4  
**increases** 40:7  
**increasing** 21:14  
 40:4  
**independent** 3:16  
 6:11  
**indicate** 45:3  
**indicated** 46:21  
 56:3 61:16  
**indicating** 51:18  
**indicator** 29:3  
**individuals** 43:11  
**Industrial** 9:20  
**industries** 8:22  
**industry** 4:1 9:14  
 9:21 30:21 31:17  
 33:11 49:11,21  
 63:5 66:3  
**inform** 34:13

**information** 4:18  
 19:8 45:7 46:10  
 46:11 47:6 51:2  
**informed** 71:5  
**infrared** 14:6  
**inhalation** 13:10  
**initial** 23:20 24:14  
 42:14 43:12 50:1  
 51:11  
**initially** 39:10 51:6  
**injured** 5:12,13 6:7  
 11:8 14:20 16:6  
 17:11 18:11 75:1  
 75:5,16  
**injuries** 16:10,12  
**injury** 36:15  
**input** 40:7  
**inside** 14:12 15:2  
 20:13 21:3,13  
 26:17 55:6 58:22  
 59:3  
**inspection** 8:19  
**inspections** 71:1,2  
**instances** 36:21  
**Institute** 10:6 32:6  
 34:5 76:10  
**intended** 31:10  
**interest** 75:22  
**intermediate** 23:9  
**internally** 53:4  
**Internation** 17:22  
**internationally**  
 13:9  
**interviews** 18:22  
 47:5  
**introduce** 8:14  
**introduction** 2:12  
 48:5  
**investigate** 9:6  
 30:10 67:5,6 68:6  
**investigated** 5:17  
 11:1 22:16 28:17  
 33:7 36:2 49:19  
 63:1 66:15  
**investigates** 3:18  
**investigating** 63:4  
**investigation** 1:2

2:14 3:20 6:2,10 6:15,17 7:21 8:2 8:13,14 9:1 10:16 18:16,21 22:6,8 66:21 70:6 71:21 72:12 73:22 75:21 <b>investigations</b> 7:6 33:10 <b>investigative</b> 4:7 71:19 72:10 <b>investigator</b> 9:1 23:1 27:6,13 37:15 44:18 <b>investigators</b> 7:7 7:16 29:11 35:6 <b>involved</b> 37:13 41:17 68:19 <b>issue</b> 4:3 63:19 64:21 <b>issued</b> 33:8 40:19 <b>issues</b> 30:7 41:18 <b>issuing</b> 32:9	16:5 17:11 47:7 75:1 <b>killings</b> 50:18 <b>kind</b> 45:2 51:11 62:15,16 <b>kinds</b> 45:3 <b>kinetic</b> 51:10,10 <b>know</b> 3:8 40:19 43:5 44:1,7 53:20 54:10,13 57:11 58:13 59:5 62:6 64:20 67:1 68:6 69:13 <b>knowing</b> 69:7 <b>known</b> 24:11 38:4 53:9 54:1	<b>left</b> 3:12 35:1 <b>lengthy</b> 36:6 <b>level</b> 39:14 <b>levels</b> 36:10 <b>licensed</b> 10:11 <b>life</b> 6:1 65:9 <b>life-threatening</b> 16:10 <b>liked</b> 65:11 <b>limestone</b> 59:2 <b>limit</b> 7:13 <b>limited</b> 32:3 43:8 47:3 <b>line</b> 12:19 14:15 28:6,6,7,11 56:6 <b>liquid</b> 20:3 <b>list</b> 35:22 64:5 <b>listed</b> 45:21 59:15 61:6 <b>literary</b> 46:9 <b>literature</b> 45:8,9,12 45:13,15,16 46:14 <b>lives</b> 75:15 <b>loaded</b> 20:4 <b>local</b> 41:16 69:17 70:9 <b>located</b> 12:11 14:6 14:17,21 16:1 <b>location</b> 70:4 <b>locations</b> 4:19 <b>long</b> 35:15 <b>longer</b> 12:10 <b>look</b> 30:2 51:13 56:1 64:11 67:1 <b>looked</b> 15:2 49:6 54:19 59:10 66:16 71:7 <b>looking</b> 45:14 47:11,16,22 48:19 49:14 64:7 <b>loss</b> 5:22 65:8,9 <b>lost</b> 6:6 <b>lot</b> 74:11 75:8 <b>lower</b> 29:16,19 46:22 55:5 <b>Lucy</b> 9:17,21 <b>17th</b> 63:18	<b>M</b> <b>magnitude</b> 59:12 <b>major</b> 3:18 <b>making</b> 50:1 68:15 68:19 69:8 <b>malfunctioned</b> 21:1 <b>managed</b> 17:16 <b>management</b> 4:2 17:17 32:2 34:11 61:3,19 62:10 <b>manganese</b> 5:9 12:16 <b>manner</b> 40:17 <b>manually</b> 29:5 <b>manufactured</b> 12:22 13:13 <b>manufacturing</b> 12:11,15 <b>Marriott</b> 1:8 <b>Mary</b> 9:7,17 31:14 <b>massive</b> 21:19 <b>master's</b> 8:17 10:6 <b>material</b> 24:12 26:12 35:21 36:16 44:19 45:18,20 46:11 53:18 67:3 67:4,16 68:14,16 69:5 <b>materials</b> 9:15 35:14 70:8,14 <b>MAWP</b> 47:12 <b>Mayport</b> 17:21 <b>McDONALD</b> 58:11,11 59:1,20 <b>McMASTER</b> 66:11,11 67:8 <b>MCMT</b> 5:10 12:17 12:20 13:1,1,4,7,9 13:13 18:18 19:21 30:1 31:3 32:19 35:14,20 36:5,9 37:6 46:7 71:5 <b>MCPD</b> 25:15 <b>mean</b> 42:8 56:5 <b>meaning</b> 58:17 <b>means</b> 28:19	<b>measure</b> 50:7 <b>measurement</b> 36:4 <b>measurements</b> 38:6 <b>measures</b> 23:11 66:17 <b>mechanic</b> 21:9 <b>mechanical</b> 8:18 <b>meet</b> 61:4,10 75:12 <b>meeting</b> 1:6 3:7,15 4:7,15,20 6:14 71:13 74:21 77:9 <b>member</b> 1:17,18,19 6:11,18 40:10 41:3 56:17 72:4 72:19,22 73:3,9 73:12,16 <b>members</b> 3:11,14 4:8,13 5:13 6:6,12 6:16 8:4 10:13 11:6 32:10 34:12 34:13,15 50:12 56:16 57:21 58:4 62:20 69:11 71:16 72:18 73:20 74:5 74:22 75:18 <b>membership</b> 32:14 <b>mention</b> 41:2 <b>mentioned</b> 35:17 35:21 40:18 48:5 62:22 66:13 68:13 <b>mentioning</b> 40:14 <b>met</b> 61:8 <b>metal</b> 14:12 20:4 24:12 25:15 <b>methylcyclopent...</b> 24:10 70:17 <b>methylcyclopent...</b> 5:9 12:16 <b>microphone</b> 60:4 <b>mile</b> 5:20,21 16:21 <b>miles</b> 5:18 11:2 14:7 <b>mind</b> 54:9 <b>minimizes</b> 44:14 <b>minutes</b> 7:14 28:16 <b>mishap</b> 71:4
<b>J</b> <b>jacket</b> 20:17 27:18 27:20 28:1 29:2 56:6,13 58:12,14 58:19 59:3,11 <b>Jacksonville</b> 1:7,8 4:11 5:7,19 10:19 11:3,19 12:12 17:14,22 18:15 58:20 72:2,15 <b>Jeffrey</b> 10:3 <b>jet</b> 21:16 <b>Jim</b> 66:11 <b>job</b> 35:7,11 37:14 <b>John</b> 1:16 3:9 <b>join</b> 40:13 <b>joining</b> 3:13 9:12 9:21	<b>L</b> <b>lab</b> 36:8 44:9 <b>laboratories</b> 1:4 4:11 5:7,15 10:19 10:21 12:8,9 52:18 53:1,5 61:11 72:1,15 <b>laboratory</b> 19:14 25:14 30:1 44:3,9 45:1,2 52:15 <b>lack</b> 49:4 <b>lacked</b> 28:18 <b>ladies</b> 10:14 <b>LAPC</b> 70:20 <b>large</b> 14:7 15:8,10 17:13 26:20,21 39:20 63:5 66:22 <b>largely</b> 46:8 <b>larger</b> 40:4 <b>lastly</b> 10:3 <b>late</b> 21:18 45:19 53:18 <b>launched</b> 52:6 <b>lead</b> 4:21 <b>leadership</b> 41:10 41:21 <b>learned</b> 31:6 <b>learning</b> 50:4 <b>learnings</b> 49:22 <b>leave</b> 6:20	<b>K</b> <b>K</b> 31:14 <b>Keeping</b> 54:8 <b>kept</b> 36:10 51:19 <b>key</b> 22:8,20 <b>killed</b> 5:12 15:22		

<b>missed</b> 51:12	<b>non-regulatory</b> 3:17	42:11	<b>paramedics</b> 74:16	<b>photos</b> 22:2
<b>misses</b> 52:10	<b>normal</b> 13:20 20:8	<b>ongoing</b> 11:12	<b>part</b> 19:18 28:2	<b>physical</b> 3:22 54:21
<b>missiles</b> 16:14	24:20 29:12 47:10	<b>open</b> 4:13 63:20	31:21 33:15 42:18	<b>picture</b> 37:18
<b>mixed</b> 20:5	<b>normalized</b> 52:2,5	<b>opened</b> 26:19	63:8	<b>piece</b> 15:10 26:21
<b>mixture</b> 61:4	<b>normally</b> 13:17	<b>opening</b> 2:12 8:4	<b>partial</b> 70:2	26:22
<b>modules</b> 32:11	59:3	28:10	<b>participants</b> 77:4	<b>pieces</b> 14:11 15:8
<b>moisture</b> 14:13	<b>north</b> 12:11	<b>operate</b> 47:13	<b>participate</b> 34:15	16:14 26:20
<b>moment</b> 4:19	<b>note</b> 4:19 7:12,15	<b>operated</b> 31:15	<b>participation</b> 75:18	<b>pilot</b> 62:13
<b>money</b> 52:21 57:14	<b>notice</b> 46:16	<b>operates</b> 66:1	<b>particular</b> 22:14	<b>pipe</b> 27:2
<b>months</b> 11:15 76:9	<b>nuclear</b> 8:17,21	<b>operating</b> 24:20	36:15,22 37:22	<b>piped</b> 27:19 28:1
<b>morning</b> 13:15,18	48:6,8,15 49:21	51:3 66:22	38:2 46:10 47:4	<b>pipng</b> 21:2 29:1
18:15 74:21	<b>number</b> 33:7 34:20	<b>operation</b> 13:21	48:19 53:8,10,18	<b>place</b> 23:11 62:12
<b>motion</b> 71:16,18	45:20 48:20 63:2	29:13 66:17 69:15	66:4 67:5 70:7,12	65:7,13,15 66:7
72:9,9,18 73:7,10	63:5	<b>operational</b> 62:12	70:16	66:16 69:21
73:21		<b>operations</b> 17:3	<b>particularly</b> 66:5	<b>planning</b> 17:18
<b>move</b> 21:11 48:13	<b>O</b>	20:9	<b>parts</b> 19:4 28:20	61:18 69:18,20
52:1 71:12,18	<b>O</b> 52:4	<b>operator</b> 20:1,10	<b>pass</b> 76:15	70:9
77:1	<b>objective</b> 6:20	20:21 28:15	<b>patent</b> 46:5,5,7	<b>plant</b> 21:7,9 31:10
<b>multiple</b> 52:9,10	<b>objects</b> 14:10	<b>operators</b> 20:15	<b>patents</b> 23:6,6,10	31:12
<b>multitude</b> 49:18	<b>obtain</b> 43:11	29:5,8	23:13 45:20,21,22	<b>plants</b> 62:13
<b>mute</b> 5:1,4	<b>occasionally</b> 30:14	<b>opportunities</b>	46:2	<b>please</b> 4:18 5:1 6:7
	<b>occasions</b> 42:15	52:10	<b>pause</b> 5:3	7:7,12 58:6,8 60:7
<b>N</b>	51:15,16	<b>opportunity</b> 6:13	<b>peer</b> 33:18	<b>pleased</b> 10:16
<b>name</b> 7:9 58:8,9	<b>occur</b> 38:20 57:2	7:11 12:3 77:6	<b>Pennsylvania</b> 9:18	<b>point</b> 4:17 7:19
60:7,8,9 62:1	76:3	<b>order</b> 38:5	<b>people</b> 7:12 16:6,12	13:21 23:21 24:1
67:21 68:11	<b>occurred</b> 5:8 10:19	<b>organizations</b>	46:16 50:2 53:9	28:9 32:22 34:16
<b>NASA</b> 52:5	19:15,17 21:22	17:12	56:20,22 57:22	36:12 47:9,10
<b>nature</b> 14:4 35:14	23:18 26:11 30:8	<b>OSHA</b> 60:17,22	60:5 67:18 74:22	49:20 51:12 55:4
59:15	30:14 44:21 52:11	61:8,13,19 62:9	75:2,12,15 77:6	59:16 74:20
<b>Naval</b> 17:21	71:22 72:14	63:9,14,19	<b>percent</b> 31:22	<b>points</b> 28:22 74:3
<b>near</b> 17:1 30:8	<b>occurrences</b> 11:17	<b>ounces</b> 26:12	<b>perform</b> 29:9 39:4	<b>poor</b> 30:13
52:10	<b>occurring</b> 76:1	<b>outcome</b> 25:11	51:7 53:1,3,4,8	<b>portion</b> 27:1
<b>nearby</b> 11:7 16:13	<b>occurs</b> 23:14 24:21	<b>outside</b> 4:22 15:1	<b>performed</b> 38:3,3	<b>possibilities</b> 45:11
20:2	25:6	49:7	39:1	<b>possibility</b> 42:7
<b>necessarily</b> 45:1	<b>octane</b> 13:4	<b>outstanding</b> 35:7,8	<b>performing</b> 38:18	<b>possible</b> 21:10
<b>necessary</b> 29:10	<b>offer</b> 7:11	37:14	53:6	59:17
68:20	<b>offered</b> 34:11	<b>oversee</b> 18:4	<b>period</b> 24:15 37:2	<b>potential</b> 28:22
<b>need</b> 29:5 30:4 32:4	<b>office</b> 16:15 17:15	<b>owned</b> 31:4	<b>periodic</b> 24:2	30:3 57:2 59:16
56:6,11,12 64:14	46:5	<b>owner</b> 21:8	<b>periodically</b> 20:16	<b>pounds</b> 14:3 15:11
<b>needed</b> 42:5 54:15	<b>official</b> 3:6 7:19	<b>owners</b> 23:4 29:22	<b>person</b> 58:9	21:14,20 26:3,16
66:17	<b>oil</b> 9:21	30:10,20 42:1	<b>pharmaceutical</b>	26:17 27:1 28:9
<b>neighboring</b> 57:5	<b>Okay</b> 69:3 71:11	49:8	10:10	<b>power</b> 56:11
<b>neighbors</b> 57:4	74:16	<b>O'Connor</b> 31:14	<b>phase</b> 71:12	<b>powerful</b> 5:16
<b>neither</b> 30:21 31:5	<b>once</b> 39:10 55:7		<b>phones</b> 5:2,4	10:22 22:1
<b>never</b> 30:16 39:5	<b>one-inch</b> 28:5	<b>P</b>	<b>photograph</b> 15:5	<b>practice</b> 38:7 63:8
61:12 71:4	<b>one-liter</b> 39:17,19	<b>Padrick</b> 60:8,9	<b>photographs</b> 74:8	63:10 66:6
<b>Nikityn</b> 9:7,12		61:21	74:9	<b>Practitioner</b> 10:1

<b>predetermined</b> 23:21	<b>process</b> 6:9 10:9 12:15,19 13:14 20:2 23:4,15,19 25:2 30:1,4 31:2,6 31:10,12,13,14,20 32:5,8,9 33:19 34:9,14 36:6 44:1 44:10 47:14 48:12 48:13 49:1 50:1 51:1,2,11,12 60:17,22 61:3,19 62:10 64:7,10,11 66:2,2 68:3,21	<b>protected</b> 55:12 <b>protecting</b> 57:14 <b>protection</b> 13:11 18:2 46:6 <b>protective</b> 36:14 <b>provide</b> 7:21 <b>provided</b> 22:19 27:18 28:4 <b>psi</b> 54:3,22 55:4,11 55:12 <b>psig</b> 46:19 <b>psychology</b> 9:8,10 <b>public</b> 1:6 3:7 4:14 5:14 6:14 7:13 11:7 12:4 67:2 <b>publicly</b> 7:6 53:22 <b>pump</b> 56:11 <b>purely</b> 46:4 <b>purpose</b> 4:6 <b>put</b> 46:16 66:6 69:12,21 <b>putting</b> 58:19 <b>P-A-D-R-I-C-K</b> 60:9 <b>P-R-O-C-E-E-D-...</b> 3:1 <b>p.m</b> 1:11 3:2 5:5 13:18 77:11	29:8 35:19 65:3 <b>quieter</b> 75:7 <b>quite</b> 65:3	21:18 22:12 26:12 26:21,22 27:9,11 27:17 28:5,7,15 29:21 32:21 33:2 33:4 39:17,19,20 40:5 42:11 44:16 51:22 55:6 56:13 61:4 <b>reactor's</b> 20:16 <b>read</b> 39:8 <b>real</b> 37:3 <b>realize</b> 75:12 <b>really</b> 41:20 47:5 47:15,20 49:4,14 63:10 67:6 68:6 <b>realm</b> 65:17 <b>rebuilt</b> 11:11 16:20 <b>received</b> 10:4 19:12 <b>recipe</b> 23:5 24:7,9 25:15 30:18 40:1 40:2 <b>recognition</b> 22:13 22:17 32:2 33:15 49:5 <b>recognize</b> 8:3 32:18 <b>Recognizing</b> 32:4 <b>recommend</b> 77:2 <b>recommendation</b> 39:5 48:11 56:21 62:9 63:19,21,22 72:11 <b>recommendations</b> 4:4 6:19,22 7:2 11:18 12:2,5 33:11,13 47:20 49:11,12,12 62:5 62:16 63:6 71:14 71:20 74:1 76:13 76:16,18,20 <b>recommended</b> 39:4 <b>recommends</b> 34:4 34:12 <b>reconstructed</b> 17:4 <b>record</b> 53:21 <b>recorded</b> 36:20 <b>recreated</b> 19:13 24:6
<b>presence</b> 18:19 60:12	<b>produced</b> 13:1 19:21 20:7 51:14 <b>producer</b> 53:15 <b>produces</b> 23:22 66:14 <b>producing</b> 12:20 13:16 20:12 22:10 32:20 35:20 40:4 46:17 53:17 <b>product</b> 13:6 23:8 46:2,6 66:14 <b>production</b> 5:9 23:12,14,17 30:6 30:9,12 31:11 38:6 39:9,12,14 42:13 46:3,8 47:10 52:11 62:14 71:5 <b>professional</b> 8:16 10:8,11,12 <b>Professionals</b> 10:2 <b>program</b> 31:8 32:8 32:10 34:10 <b>programs</b> 31:9,11 31:16,20,22 33:20 33:22 34:3,8,14 <b>promote</b> 31:16 <b>proper</b> 56:22 68:21 <b>properly</b> 54:7 <b>proportions</b> 24:13 <b>propose</b> 33:13 <b>protect</b> 55:2	<b>quality</b> 33:19 <b>quantity</b> 40:4,5 <b>quarter</b> 5:21 <b>quarters</b> 40:1 <b>question</b> 36:18 37:21 38:17 39:7 41:22 47:18 48:2 50:15 58:6,16,16 59:7 60:16 66:12 67:19 68:7 70:1 71:11 <b>questions</b> 2:17 6:16 7:16,18 34:17 35:5 37:15 50:12 50:13 56:15 57:19 57:20 58:4 62:2 <b>quickly</b> 25:6,8,22	<hr/> <b>R</b> <hr/> <b>rack</b> 27:2 <b>radius</b> 16:22 <b>railroad</b> 27:3 <b>rained</b> 15:1 <b>raised</b> 7:20 39:13 <b>ran</b> 29:8 <b>rapidly</b> 14:1 <b>rate</b> 25:4 <b>raw</b> 70:13 <b>reach</b> 23:8 37:6 49:13,15,16 <b>reached</b> 20:9 26:17 28:8 <b>reaching</b> 21:14 <b>reacting</b> 14:12 <b>reaction</b> 5:8 10:18 13:17,19,21 19:14 19:15 20:7,11 21:5 23:21,22 24:2,5,21 25:4,6 25:16,19 26:11 27:22 28:3,8,13 29:8,14,18 30:3 32:18 33:3 37:20 37:20 38:21 42:2 42:15 45:12 47:11 51:10 55:10 65:5 68:2 <b>reactions</b> 27:14 30:8 45:4 48:1,1 51:9 76:5 <b>reactive</b> 22:17,18 30:22 31:2,7 32:1 32:5,12 33:7,9,15 34:6,10 45:10 49:2,18 63:2,20 64:3 76:7 <b>reactor</b> 13:13 14:1 14:12,18 15:2,8,9 15:10,13 16:2,8 19:2,4 20:1,5,13 20:22 21:4,12,13	

<b>Red</b> 18:3	<b>repeatedly</b> 28:2	53:11	66:17 76:2,12	<b>seriously</b> 75:5,16
<b>reduced</b> 59:22	<b>replicate</b> 37:17	<b>returned</b> 21:6	<b>samples</b> 36:7	<b>served</b> 8:22
<b>reducing</b> 33:12	<b>replicated</b> 38:1	<b>review</b> 33:19 34:2	<b>Sandra</b> 60:8	<b>service</b> 53:5
<b>redundancy</b> 28:19	<b>report</b> 2:14 4:9,16	<b>reviewed</b> 19:11	<b>saw</b> 27:8 48:20	<b>set</b> 23:21 29:14,15
<b>reenactment</b> 11:22	6:14,18 7:1 12:5	<b>reviews</b> 33:22	51:15 74:8	46:19,21 47:9,10
19:16,20	21:7 34:18 39:3,9	<b>Rick</b> 68:11	<b>scale</b> 23:12 29:2	54:20,22 55:3,10
<b>reestablished</b> 43:2	45:22 46:15,20	<b>right</b> 3:11 45:2	37:21 58:22 59:13	<b>setting</b> 75:8
<b>refer</b> 5:10 44:12	48:4 69:17 70:9	67:8	<b>scaled</b> 37:16 39:9	<b>seven</b> 27:12 63:17
<b>reference</b> 74:6	70:11,16,19 71:14	<b>rings</b> 52:5	<b>scenario</b> 11:22	<b>severe</b> 11:14
<b>referred</b> 67:21	71:19 72:10 73:22	<b>rise</b> 13:20 20:14	<b>Sciallo</b> 9:17	<b>severely</b> 17:11
<b>referring</b> 69:1,1	<b>reported</b> 13:19	21:4 25:4,17,21	<b>Science</b> 9:19	<b>shards</b> 16:15
<b>refers</b> 63:9	28:15 70:13	38:7	<b>Scoppa</b> 68:11,12	<b>shattered</b> 15:4
<b>refining</b> 66:3	<b>reporting</b> 70:2,3,8	<b>rises</b> 25:7	69:2,4	<b>sheet</b> 57:22 58:1
<b>regard</b> 63:6,11	<b>report's</b> 6:22	<b>rising</b> 26:2,15	<b>screen</b> 14:8	<b>shell</b> 15:9
<b>regarding</b> 34:18	<b>requests</b> 19:10	30:15	<b>search</b> 45:8,13,16	<b>sheriff's</b> 17:15
71:20 72:12	<b>required</b> 16:10	<b>Road</b> 12:20 15:14	<b>searched</b> 21:8	<b>short</b> 37:2
<b>regardless</b> 64:2	23:20 27:21 28:3	16:18	<b>seat</b> 3:5	<b>shortly</b> 13:18 15:3
<b>region</b> 26:1	31:21 34:7 60:14	<b>Robert</b> 8:13	<b>second</b> 5:4 24:20	17:7
<b>Registered</b> 8:15	62:11 64:6	<b>Rogers</b> 67:20,21	24:22 25:6,19	<b>show</b> 22:2 45:3
<b>regularly</b> 58:13	<b>requirement</b> 61:5,7	68:8	26:3,4,10,16	74:11
<b>regulated</b> 13:11	61:8,10 62:3	<b>room</b> 1:8 4:20,21	29:17 42:2,6,19	<b>showed</b> 37:18
35:21	<b>requirements</b>	15:21 20:3 21:10	48:4 56:6 67:12	<b>showered</b> 15:3
<b>regulation</b> 9:16	22:12 47:16 69:14	56:8	68:2 72:6	<b>shown</b> 44:19
70:7,12,12	69:16	<b>root</b> 32:15,17	<b>secondary</b> 16:14	<b>shows</b> 14:3
<b>regulations</b> 4:1	<b>requires</b> 24:2 70:8	<b>rose</b> 28:13	37:19 56:4,9	<b>shut</b> 23:22 65:21
63:11,15	<b>Rescue</b> 17:15	<b>route</b> 50:6	<b>seconder</b> 72:5	<b>shuttle</b> 52:6
<b>regulatory</b> 9:13	<b>research</b> 12:14	<b>routine</b> 55:18	<b>secondhand</b> 47:5	<b>side</b> 12:12
33:11 49:8,10	<b>researching</b> 11:15	<b>run</b> 25:14 43:15	<b>Secondly</b> 51:13	<b>sign</b> 7:8 57:21 58:1
63:5 68:18	<b>Resource</b> 17:17	<b>runaway</b> 5:8 10:18	<b>seconds</b> 3:4 21:19	<b>signed</b> 7:10
<b>related</b> 3:22	<b>respect</b> 38:19 50:5	19:15 21:4 29:14	26:18	<b>significant</b> 54:5
<b>relatively</b> 37:2	<b>respectively</b> 18:5	29:19 32:18 33:3	<b>sectors</b> 10:11	<b>significantly</b> 46:22
<b>release</b> 27:16	<b>respond</b> 74:13	38:20 45:11 76:4	<b>security</b> 14:22	59:22
<b>released</b> 19:19 37:1	<b>responded</b> 17:12	<b>rupture</b> 21:15	<b>see</b> 14:8,10,14,22	<b>similar</b> 4:5 7:3
<b>releasing</b> 33:3	18:3 74:7	28:10 46:18 54:8	15:7 16:2 17:5	<b>similarities</b> 48:20
<b>relief</b> 22:12 28:4,6	<b>responders</b> 35:10	54:9,15	26:9,20 66:16	<b>similarity</b> 49:4
33:2 38:10,11	41:6 74:6,16		67:1 69:10 74:10	<b>single</b> 13:13 28:19
54:19,20 55:10	<b>response</b> 18:6	<b>S</b>	<b>seek</b> 33:14	32:22 59:16 64:12
<b>relieve</b> 55:2,13	19:12 35:8 36:13	<b>safe</b> 40:17	<b>seen</b> 21:21 65:11	64:13
<b>relieved</b> 46:22	40:15,16,20,22,22	<b>safely</b> 18:8	<b>selling</b> 13:2	<b>sir</b> 57:9
<b>relieves</b> 55:5	41:10 69:9,20	<b>safety</b> 1:1 3:8 4:2,3	<b>sense</b> 50:16	<b>site</b> 12:21 15:6 16:3
<b>relocate</b> 17:3	74:18	4:18 9:20,22 10:1	<b>sent</b> 36:7 70:20	16:3 18:4,17,19
<b>remarks</b> 74:3	<b>rest</b> 75:15	10:2,7,9,12 19:18	<b>separate</b> 65:14,22	18:20 19:3 35:13
<b>remove</b> 24:3 29:20	<b>restate</b> 72:9	23:11 31:6,13,15	74:21	35:16 36:11,14,18
59:3	<b>result</b> 32:20 76:4	31:17,20 32:5,8	<b>separately</b> 64:16	36:21 37:4,5 43:9
<b>removed</b> 20:18	<b>resulted</b> 5:11 6:4	32:10 34:9 41:5	<b>September</b> 1:9	43:12 57:3 69:19
<b>removes</b> 55:8,9	33:4	46:3 48:7,8 60:18	63:18	70:4,15,22 71:2,4
<b>repeat</b> 58:15	<b>results</b> 23:1 25:13	61:3,19 62:10	<b>serious</b> 35:8	71:6 75:3

<b>situation</b> 40:8	<b>spell</b> 58:8 60:7	17:20 19:7 37:5	<b>T</b>	44:18 45:1,2 51:8
<b>six</b> 26:13 52:22	<b>spend</b> 52:21	<b>struggle</b> 64:20	<b>table</b> 2:10 7:8 9:7	52:15,20,21 53:2
53:5	<b>spent</b> 11:8,14 53:7	<b>student</b> 9:10 32:13	39:11,18	53:3,10 54:18
<b>size</b> 26:7 38:1 40:1	57:14	34:11,13,15	<b>take</b> 3:5 4:18 7:16	60:22 61:9,12
47:9 54:19,20,21	<b>spot</b> 69:13	<b>students</b> 76:6	48:10 71:13	64:22 65:2 67:13
55:1,11	<b>spread</b> 11:4	<b>study</b> 6:13 33:9,10	<b>taken</b> 14:5 27:21	68:20
<b>skilled</b> 11:6	<b>square</b> 15:22 21:15	<b>subject</b> 60:11	59:14	<b>Texas</b> 31:15
<b>skin</b> 13:10	26:4,16,18 28:9	<b>submitted</b> 19:9	<b>talk</b> 41:18 60:11	<b>thank</b> 5:4 8:1,11
<b>slow</b> 43:21	<b>staff</b> 3:14 7:21	70:11	<b>talked</b> 40:16 64:8	9:3 23:3 27:6
<b>slowed</b> 29:18	<b>stage</b> 23:19 51:7	<b>substance</b> 13:12	<b>talking</b> 56:9 66:2	34:19 35:3 37:10
<b>small</b> 26:6 39:11	<b>standard</b> 24:6 38:7	70:18	<b>tall</b> 27:10	40:9,12 50:9
48:21 49:2,6,15	44:9 60:11,18	<b>substances</b> 36:1	<b>tank</b> 15:17 56:10	56:18 57:10 61:21
<b>smaller</b> 14:10	63:8 64:5	<b>summary</b> 11:21	<b>team</b> 4:7 6:15,17	61:22 65:18 66:8
<b>smokestack</b> 14:14	<b>standards</b> 4:2	<b>sunlight</b> 37:1,6	8:1,14 9:5 10:16	67:8,17 68:8 71:9
14:15	63:12	<b>supervisor</b> 8:13	18:13,14,21,22	72:3 74:17 75:17
<b>smoothly</b> 41:8,15	<b>standpoint</b> 46:8	<b>supply</b> 21:2 29:1,1	19:6 22:4,5,8,16	77:3,4,6
41:20	<b>start</b> 23:20 35:1	29:6 56:11,12	22:21 24:4,13	<b>thanks</b> 75:19
<b>sober</b> 75:7	50:14 55:7 73:8	<b>support</b> 27:10	28:17 32:16 34:4	<b>thermal</b> 37:19
<b>sobering</b> 75:11	<b>started</b> 39:10 68:15	<b>supported</b> 15:13	34:12,17 35:18	44:12 51:8
<b>soda</b> 26:8	68:17 69:6	<b>sure</b> 50:2 68:19	59:18 75:19	<b>thing</b> 40:18 41:5
<b>sodium</b> 14:11 20:4	<b>starting</b> 3:4 44:1	76:19,22	<b>teams</b> 25:14	52:8
24:12 70:14 71:1	50:22	<b>surrounding</b> 19:4	<b>team's</b> 12:1,5	<b>things</b> 52:14 62:8
71:4	<b>state</b> 9:18 41:16	<b>surveillance</b> 14:6	<b>techniques</b> 36:4	65:10
<b>sold</b> 13:5,7	58:8	<b>survey</b> 31:19	<b>Technology</b> 10:7	<b>think</b> 37:14 46:20
<b>solvent</b> 12:13	<b>statement</b> 8:4	<b>surveyed</b> 17:19	33:21	48:4 63:17 69:22
<b>solvents</b> 15:18	<b>States</b> 52:19 53:1	<b>susceptible</b> 32:22	<b>tell</b> 60:6	<b>thinking</b> 46:17
60:12 64:4 70:13	<b>Station</b> 17:21	<b>sustain</b> 24:1	<b>temperature</b> 13:20	<b>third</b> 40:6
70:22	<b>steel</b> 15:12 27:10	<b>sustained</b> 16:9,18	13:22 20:9,13,19	<b>thoroughly</b> 44:5
<b>somewhat</b> 43:8	<b>step</b> 20:3 23:15,15	<b>sympathy</b> 6:8	21:3 24:20 25:3,7	<b>thought</b> 50:7
<b>soon</b> 19:19	24:7,14 25:2	<b>Syracuse</b> 10:5	25:17,21 26:1	<b>thousand</b> 15:14
<b>sophisticated</b> 52:15	26:14 30:4,5,15	<b>system</b> 20:2,11	28:13 29:3 30:7	16:7
<b>sort</b> 42:22 48:2,7	42:3 47:15 60:21	21:1 22:13 24:3	42:16 51:17 55:19	<b>thousands</b> 15:17
52:20	61:1,2	28:18,21,21 29:4	65:5	19:11
<b>sound</b> 21:16	<b>steps</b> 23:9 47:13,14	29:12 32:21 33:2	<b>temperatures</b>	<b>three</b> 7:14 30:9
<b>source</b> 45:7 56:4,9	<b>stood</b> 15:8	49:17 54:7 55:17	27:15 30:14	40:1 43:13 47:12
64:12,13,15	<b>stop</b> 42:17 76:16	55:18,19,22 56:12	<b>ten</b> 21:18 27:11	47:14 51:15
<b>Southern</b> 9:9	<b>stopped</b> 29:18	59:17,19 62:12	28:16 30:9 43:13	<b>three-inch</b> 54:4
<b>specialist</b> 9:13,22	<b>stopping</b> 51:20	63:13 64:17,18	43:14 51:14,15,16	<b>three-step</b> 13:14
<b>specialized</b> 34:1	<b>stores</b> 13:6	65:7,13,20,21,22	<b>terms</b> 45:10 50:22	23:5
36:7 44:14	<b>storing</b> 37:5	66:1 68:21	<b>terrible</b> 75:12	<b>thrown</b> 15:9 16:15
<b>specializing</b> 10:9	<b>straight</b> 39:20	<b>systematically</b>	<b>test</b> 26:9 38:2 44:10	27:2
<b>specialty</b> 10:10	<b>strength</b> 19:8	30:10	44:13,15,17 51:9	<b>tier</b> 70:8
12:12 13:6	<b>strong</b> 6:21 75:22	<b>systems</b> 4:2 8:20	53:8,10	<b>time</b> 7:9 8:12 12:21
<b>specific</b> 22:11 31:7	<b>structure</b> 14:18	27:16 62:4,10	<b>tested</b> 26:6	29:9 34:17 37:3
32:1 33:19 34:14	15:8 16:14 17:7	63:7	<b>testing</b> 18:19 23:2	41:3 47:1 52:4
44:10	27:10 41:7	<b>S-C-O-P-P-A</b>	30:1,2 39:17	61:18,20
<b>specifically</b> 32:12	<b>structures</b> 16:20	68:12	42:10,10 44:4,9	<b>times</b> 67:22

**TNT** 14:3 21:20  
**today** 3:10 33:13  
**today's** 77:4  
**told** 71:7  
**tonight** 9:5 11:17  
**tons** 26:13  
**top** 27:1 28:5,7  
     39:11,18 53:9  
**topics** 55:16  
**towers** 14:7  
**toxic** 13:9 18:18  
     36:16  
**toxicity** 46:12  
**track** 27:3  
**tradename** 13:3  
**tragedy** 50:18  
     75:13  
**tragic** 5:22 75:22  
**trailer** 17:5  
**training** 9:14  
**transfer** 44:15  
**tribute** 41:21  
**tricarboxyl** 5:10  
     12:16  
**tried** 20:21  
**trucking** 17:6,8  
**trying** 51:20  
**turn** 9:2 20:10 59:6  
     62:18  
**twinkling** 14:11  
**two** 14:7 15:12,21  
     23:16 25:18 26:12  
     26:20 32:11 54:19  
     70:9  
**two-part** 48:2  
**type** 53:10  
**typical** 55:22  
**typically** 49:6  
**T2** 1:4 4:11 5:6,15  
     10:19,21 11:5,6  
     12:9,12,13,18,21  
     13:1,7,13,16 15:6  
     15:21 16:5,9 17:1  
     17:6 19:1,10,18  
     19:21 22:1,3,9  
     24:5,7,13 25:15  
     28:15 29:22 30:15

31:4 32:18 35:20  
 39:3 55:1 56:3  
 57:12 61:11 69:1  
 69:2 72:1,14  
**T2's** 19:13 21:6  
     22:16 23:4 25:9  
     26:12 30:10,20

---

**U**

---

**Ultimately** 4:3  
**unable** 18:16  
**unaware** 38:14  
     49:9 57:16  
**uncertainty** 65:17  
**uncontrollable**  
     25:11  
**uncontrollably**  
     13:22 25:8 28:13  
**uncontrolled** 24:5  
     42:18  
**undergraduate**  
     22:19 31:19 33:16  
     34:3  
**understand** 35:12  
     50:2 58:16 68:17  
     69:6  
**understanding**  
     22:21 47:2 69:22  
**undesirable** 25:19  
**undesired** 24:21  
     25:6 26:11  
**undetected** 25:12  
**unfortunately** 47:7  
     58:2  
**United** 52:19 53:1  
**universe** 46:9  
**University** 9:9,11  
     9:19 10:5 31:16  
**unknown** 65:17  
**unnecessary** 5:22  
**unregulated** 49:7  
**unsafe** 16:19 17:2  
     17:20  
**unusual** 65:20  
**ups** 43:11  
**urging** 48:11  
**use** 30:17 41:19

51:10  
**usual** 20:22  
**U.S** 1:1 3:8 13:5,7

---

**V**

---

**valve** 21:2 38:10,12  
     56:7  
**valves** 29:1  
**variations** 30:13,17  
**various** 70:13  
**vent** 21:17 27:20  
     28:6,10 29:12  
     55:9  
**vented** 20:8 38:4  
**venting** 24:16 25:1  
     29:19  
**vents** 26:19 29:15  
     37:22 38:1  
**venture** 65:16  
**vertically** 27:9  
**vessel** 19:3 26:17  
     37:18,22 39:11  
     44:20 47:12 54:2  
     54:4,11,12,17  
     55:2,12 58:12,14  
     58:17,19 59:10  
**video** 14:3,22 19:18  
     27:8 40:19  
**views** 22:3  
**Visscher** 1:17 3:11  
     8:5,6 40:11,12  
     42:20 43:4,17,22  
     44:22 45:6 46:13  
     47:18 48:17,18  
     50:9 73:4,5,17,18  
**Visscher's** 50:15  
**VOICEOVER**  
     19:21  
**voluntary** 33:18  
**vote** 2:19 4:9,16  
     6:18 12:4 71:13  
     73:8 76:15

---

**W**

---

**waiting** 18:20  
**walked** 57:22  
**Wanko** 10:3,4,7,11  
     23:1,3 27:7,13

34:20 44:18  
**want** 40:13 62:6  
**wanted** 41:2 42:3  
     44:1 47:13  
**Wark** 1:18 3:12 8:7  
     8:8 35:2,3 36:17  
     37:7 40:14 56:17  
     56:18 57:10 71:17  
     72:4,19,20 73:9  
     73:11  
**warned** 21:11  
**Warner** 1:22 3:14  
**wash** 59:4  
**Washington** 9:11  
**wasn't** 41:4 42:12  
     56:4  
**waste** 9:15  
**water** 20:17,17  
     21:2 27:19,21  
     28:1 29:6 56:4,13  
     58:14,18,20 59:21  
     64:13,15  
**way** 41:11 44:2  
     49:14 52:3 55:13  
     65:12 77:1  
**weeks** 18:17 36:11  
**weighing** 15:11  
     27:1  
**welcome** 3:7  
**went** 21:9 25:11  
     37:19 39:12,20  
     41:3 51:17  
**weren't** 42:6  
**Wess** 62:1  
**wether** 61:12  
**we'll** 3:3,5 5:10  
     12:3 71:12 73:7,8  
     73:8  
**we're** 48:10 49:14  
**we've** 49:10,12,19  
     50:17,17 59:20  
**Wheeler** 62:1,2  
     65:6 66:8  
**wholeheartedly**  
     62:7  
**wide** 11:3 27:12  
**William** 1:18,19

3:11,12  
**windows** 15:4  
**wired** 64:17 65:14  
     65:22  
**wishes** 7:5  
**WITNESS** 44:8  
**Witnesses** 21:16  
**woods** 19:5  
**wore** 36:14  
**work** 8:2 25:9  
     33:14 34:5,21  
     39:19 41:9 47:7  
**worked** 9:12,21  
     30:22  
**worker** 21:7  
**workers** 15:1,2  
     18:5  
**working** 11:7 14:20  
     16:7,13 17:9  
     76:10  
**Wright** 1:19 3:12  
     8:9,10 37:9,10  
     38:9,13 39:7 40:9  
     72:6 73:1,2,13,14  
**written** 46:4

---

**Y**

---

**years** 8:19 10:8  
     12:18 63:3,17  
     67:1 76:17  
**yields** 30:13

---

**\$**

---

**\$125,000** 53:7

---

**0**

---

**03** 72:11

---

**1**

---

**1** 72:11  
**1:00** 13:18  
**1:30** 5:5  
**10** 26:18  
**11** 31:21  
**118** 16:6  
**12** 12:22  
**12-foot** 15:22  
**1400** 14:3 21:20



<b>15</b> 1:9 5:18 11:2	<b>460</b> 14:8		
<b>150</b> 32:13	<b>48</b> 18:22		
<b>16</b> 10:8 14:19			
<b>174</b> 12:22	<hr/> <b>5</b> <hr/>		
<b>175</b> 59:21	<b>50</b> 16:1 24:12 44:19		
<b>175th</b> 13:16	<b>500</b> 25:20 26:3,15		
<b>19</b> 72:1	<b>5000</b> 26:17 54:3		
<b>19th</b> 4:10 5:5 10:20	<hr/> <b>6</b> <hr/>		
13:15 18:14 19:16	<b>6:00</b> 1:11 3:2		
72:14	<b>620</b> 14:17		
<b>1950</b> 23:6	<b>640</b> 14:16		
<b>1950s</b> 45:19 53:18			
<b>1996</b> 12:13	<hr/> <b>7</b> <hr/>		
<b>1998</b> 33:6 63:4	<b>7:30</b> 77:11		
<hr/> <b>2</b> <hr/>	<b>70</b> 26:2		
<b>2T</b> 12:7	<b>700</b> 14:21		
<b>2000</b> 12:13 15:11	<b>71</b> 2:19		
27:1	<b>75</b> 55:4,10		
<b>2002</b> 33:8 63:18	<hr/> <b>9</b> <hr/>		
<b>2004</b> 13:1	<b>9</b> 2:14		
<b>2006</b> 31:18	<b>90</b> 18:9		
<b>2007</b> 4:10 5:6 10:20			
12:21 13:2,16			
72:1,14			
<b>2008</b> 32:9 72:11			
<b>2008-03-I-FL</b>			
71:20			
<b>2009</b> 1:9			
<b>25</b> 8:19 45:21			
<b>2500</b> 19:22			
<b>28</b> 5:13			
<hr/> <b>3</b> <hr/>			
<b>3</b> 2:12			
<b>30</b> 3:4 24:19			
<b>300</b> 20:9			
<b>31</b> 16:6			
<b>35</b> 2:17			
<b>360</b> 20:15			
<b>390</b> 24:18			
<b>390-degrees</b> 25:18			
<hr/> <b>4</b> <hr/>			
<b>400</b> 15:11 21:14			
27:4 28:9 46:19			
54:22 55:12			
<b>42</b> 39:22 40:3			