

Date: January 17, 2014

Case: Research and Development Forum Meeting



Ace-Federal Reporters, Inc.
Phone: 202-347-3700
Fax: 202-737-3638
Email: info@acefederal.com
Internet: www.acefederal.com

RESEARCH AND DEVELOPMENT FORUM

MEETING

1/17/2014

8:30 am

Department of Transportation

1200 New Jersey Avenue, S.E.

Washington, DC 20590

The research and development forum
meeting, pursuant to notice, convened at 8:40 a.m.,
Ryan Paquet chair of the meeting.

- 1 SPEAKER LIST
- 2 RYAN PAQUET, Chair
- 3 DR. MAGDY EL-SIBAIE
- 4 DR. CAROLE LEBLANC
- 5 LUCY DIGHIONNO
- 6 CYNTHIA HILTON
- 7 BOB RICHARD
- 8 DR. JOSEPHINE COVINO
- 9 JOSEPH NICKLOUS
- 10 BEN BARRETT
- 11 GREG SMITH
- 12 LEONARD MAJORS
- 13 JOHN CONLEY
- 14 RICHARD GUPTON
- 15 JAMES SIMMONS
- 16 JOHN O'NEIL
- 17 MARK TOUGHIRY
- 18 RICHARD HOPKINS
- 19 RICHARD MILLER
- 20 BENJAMIN MOORE
- 21 CL PETTIT
- 22 SUSAN NAUMAN

- 1 SPEAKER'S LIST (CONTINUED)
- 2 MARK RANEY
- 3 BOYD STEVENSON
- 4 JIM GOLDSTEIN
- 5 BRIAN VOS
- 6 LON SANTIS
- 7 DR. RICHARD TARR
- 8 JULIE HECKMAN
- 9 DR. REFAAT SHAFKEY
- 10 MIKE CALDARERA
- 11 STEVEN GENTRY
- 12 WILLIAM FINK
- 13 SARAH ABDELKADER
- 14 DR. STEVE HWANG
- 15 DR. KIN WONG
- 16 BILL VOCKE
- 17 RICHARD BORNHORST
- 18 TOM SCHICK
- 19 DEPUTY ADMINISTRATOR TIM BUTTERS
- 20
- 21
- 22

1 PROCEEDINGS

2 MR. PAQUET: Good morning everyone, good
3 morning. I think I am going to have to lean into
4 the microphone so you guys can all hear me, but good
5 morning everyone. Thank you for coming today, I am
6 Ryan Paquet, I am the Director of Approvals and
7 Permits here at PHMSA Hazmat Safety and I'm your
8 emcee for today so if you misbehave you get to deal
9 with me.

10 We have a lot to do today so I am going to
11 start off with a safety briefing. Safety is our
12 middle name here at PHMSA and so that's important
13 that we set up those rules. This building has a fire
14 alarm and there is one in the back and I'm sure there
15 is a couple more throughout this room as they can
16 close these partitions off. If that fire alarm goes
17 off there will be an announcement that says what you
18 need to do.

19 This building is also, this room right
20 here there is also a shelter in place for this
21 building and I don't know if any of you are aware but
22 in recent history we have had to shelter in place in

1 this building unfortunately. If that happens, look
2 for one of us PHMSINS's or a DOT'er and we will tell
3 you what to do, likely if we shelter in place we will
4 be staring at each other so we will continue on.

5 Other than that, the rally area for a fire
6 emergency is down by the river, it is really pretty
7 down there, you guys can see the new restaurants
8 hopefully we won't have to see them now. You all
9 have badges very few of you have pictures on your
10 badges so that means once you walk out of security
11 you have to hand over that badge.

12 To go out of the building you are going to
13 lose that badge, you will have to go through security
14 to get back in. The main entrance which is our
15 closest one, that's the one you would have to come in
16 and come out of, there is another entrance and exit
17 over here but you can't get your badge back through
18 that entrance so the main entrance you guys came in
19 through today that's the one that you will want to go
20 out and in so if some of you have bad habits
21 throughout the day, that's what you are going to have
22 to go through.

1 Restrooms out any of these doors, take a
2 right at the end of the hallway there are two
3 restrooms right there. Coffee, water all that, I
4 believe that there are water fountains down there but
5 then we have a little coffee shop right here. If you
6 just go out these doors, take a left and another
7 left, there is a little coffee shop with soda and
8 snacks and things like that.

9 Cell phones we all know the drill, yet so
10 few of us remember to do it. Please silence them,
11 you don't have to throw them away just silence them.

12 We have a court reporter today Larry is
13 our court reporter. He is going to help us out and
14 all of this will be on the docket following the
15 meeting and available.

16 Comments we have a lot to do today okay,
17 we have a lot of presentations. If you can see the
18 agenda it is pretty tight, so the way we set it up is
19 we have about ten minutes for the presenter and about
20 ten minutes for comments. That means that if you
21 stand up with a pre-prepared comment that is going to
22 take you fifteen minutes in your dry run, I am going

1 to tell you to stop, just setting expectations right
2 now.

3 We want your comments and if you can't
4 provide all of your comments today either right after
5 the presentation and at the end of the agenda you see
6 there is a few hours for comments. If you can't do
7 it in those two time periods then send them in. We
8 are going to provide an opportunity for all of the
9 comments to come in. This forum is so that we can
10 hear your comments. Although I'm joking around and
11 saying that I will stop you if you run over your five
12 minutes allotted time, that I'm not joking around
13 about, I will do that but we want to hear your
14 comments. We need your comments because we need to
15 go forward with, or facing some of the problems that
16 we are dealing with.

17 If we may ask you when you conclude your
18 remarks to clarify some things that we didn't
19 understand please don't interpret this to support or
20 opposition to anything you said. Please don't be
21 that sensitive it's an R & D forum. We all are
22 trying to find solutions to the problems that both

1 industry and the office of Hazmat Safety faces.

2 Before we start the speakers, I want to
3 remind everybody of PHMSA's mission. Our mission is
4 to protect people and the environment from the risks
5 inherent in the transportation of hazardous
6 materials. That's what we base our decisions on,
7 that's how we think so if you hear something up here
8 today that is in contrast to that mission you can
9 always call us out on that, but also if you are
10 opposed to something we say and you are not coming
11 from that vantage point, it is a lot more difficult
12 for us to consider where you are coming from because
13 that is our mission and being a government agency,
14 thankfully we have a noble mission but it also
15 simplifies things because we don't have to worry
16 about the other stuff, we just have to worry about
17 our mission. That's what we are trying to do and we
18 have been pretty good at it. So now I would like to
19 introduce Dr. Magdy El-Sibaie, our Associate
20 Administrator for Hazmat Safety.

21 DR. EL-SIBAIE: Thank you good morning
22 everyone. I must confess I did not expect this crowd

1 so I thank you for coming and for participating first
2 and foremost. I am not going to be speaking for too
3 long, I just want to share with you quickly and
4 briefly some of my thoughts, where I believe we are
5 and where I believe we need to go.

6 And I want you to appreciate and factor in
7 all of what we do today and say that our R&D program
8 is rather small, at least from my perspective it is
9 less than two million annual funding it is very,
10 very small. I came to PHMSA from FRA where I use to
11 run an R&D program at FRA and our budget was
12 somewhere between forty and fifty million in the real
13 side. And I don't know how I did at FRA, maybe some
14 of the audience here can tell me but I thought and I
15 may have been under a huge illusion, I thought we did
16 a fairly well, ran a fairly well program and did a
17 very good job in running the successful or what I
18 felt a successful government funded R&D program.

19 Some, not everything, not too many, but at
20 least some, few of the items and the products that
21 are being used by many of the class one railroads
22 today, many of these products or at least some that I

1 can think of originated in my shop and some of the
2 ideas that went into practice and are being used to
3 monitor and inspect our tracks every day today and
4 our equipment, and rolling stock originated by ideas
5 here in government and specifically at FRA.

6 So I've seen it, I've lived through it, I
7 know what a successful R&D program could look like
8 and what are the basic ingredients and I'll maybe
9 briefly, very quickly share with you some of my
10 thoughts.

11 Where are we at PHMSA? We are a small
12 agency with a small R&D budget, but with a huge and a
13 big mission. A million shipment of Hazmat, at least
14 we think a million shipment of Hazmat daily in
15 different types of transportation modes and different
16 conditions and different materials presenting the
17 public and transportation workers and the shippers
18 and the carriers with a variety of risks and a
19 variety of challenges.

20 We are fortunate that we have a fairly
21 mature set of regulations on the Hazmat
22 transportation side. A lot of these regulations, if

1 not the bulk of these regulations were developed by
2 the industry or in conjunction with the industry so
3 PHMSA cannot take a complete ownership or be proud of
4 it all we are proud of it with you and as a result of
5 your combined efforts that we have in the U.S. we
6 have a fairly mature set of Hazmat regulations.

7 What we also have in the U.S. we have an
8 industry that by and large, by and large, follows the
9 regulations and wants to follow the regulations so
10 the safety record that we have today is a very
11 impressive and a very good safety record. So why do
12 you need R&D, what is R&D going to do and how is
13 PHMSA going to do R&D independent from the industry,
14 all of these questions we need you to help us better
15 answer and better solve.

16 I don't believe in a completely
17 independent R&D program that is devoid and completely
18 isolated from any input from the industry. That
19 doesn't work, so we need your input and we need your
20 participation and it may be admissible and acceptable
21 in many cases to have a combined R&D initiative or
22 effort. I look forward to that. It hasn't happened

1 much in the past, but certainly it could happen, it
2 could begin to happen more robustly in the future but
3 we also cannot have and we shouldn't have an R&D that
4 is completely directed by the industry and doesn't
5 factor in the public interest and doesn't address
6 what we believe jointly with you to be safety
7 challenges.

8 And on the Hazmat side, I'm not going to
9 say unlike the real side, but even more so that the
10 real side, on the Hazmat side because of the
11 different industries and the different types of
12 shipments and the different modes of transportation,
13 the challenges are far greater and far more
14 disbursed. So we have a lot of challenges and I hope
15 through the presentations today you will see at
16 least, get a flavor of what of the few items that we
17 have worked on. I have directed the staff and I
18 asked and I hope they responded to minimize the
19 amount of time we spend on what we have done,
20 although certainly give it it's fair share, but to
21 spend more time on what we are planning to do.

22 And even though spend time on how should

1 we do it, or are we doing it right and can we do it
2 differently, that's my own bias, if the audience
3 doesn't want to do that, if the audience wants to
4 dwell a little bit more on what has been done in the
5 past, that's fine, obviously we will indulge you but
6 I thought we should productively, certainly factoring
7 in the past but as much as possible looking forward.

8 I have my own ambitions and goals
9 obviously I want to grow the program but I don't want
10 to grow the program for the sake of growing it. I
11 want to grow the program because I believe it's a
12 limit and I believe it's not responsible enough given
13 the needs and the safety conditions and the safety
14 questions that we all have out there.

15 As an agency and a duty we get I don't
16 want to say distracted, but we get our attention
17 divided between you know different issues depending
18 on the crisis of the day sometimes. It is no secret
19 to many of you that one of the issues that is
20 occupying us and will continue to occupy us in the
21 next few months if not a couple of years, is the
22 issue of rail transportation and specifically Hazmat

1 include oil, and flammable liquid transportation by
2 rail. Really bulk shipment of Hazmat by rail, where
3 we have a situation where graphically in spite of the
4 best efforts by everybody and I mean that, because I
5 know firsthand what some of the steps that the
6 railroads take and we do have derailments and these
7 derailments occur and there are people who suffer and
8 we had a severe accident in Canada our neighbor to
9 the north where fifty people, almost fifty people
10 lost their lives completely in an entire town, a
11 beautiful town, I've seen pictures before the
12 destruction, I wish I could live there. A beautiful
13 town that was the center of the town was completely
14 wiped out and I invite you if you have not seen
15 already looking at the aerial photos of the site
16 after the derailment, a complete disaster, all
17 because we are shipping crude oil and we have to
18 continue to ship crude oil by rail because that is a
19 viable commodity and our options are limited.

20 So you can imagine the immense amount of
21 safety and technical challenges that our staff here
22 faces, along with the industry and everybody else in

1 insuring that that gets done and more safely. So
2 there are many, many questions and there may be R&D
3 issues and challenges that may arise from that
4 situation but I will tell you what also I would like
5 to do and what I have begun to do at PHMSA.

6 We want to build on a risk based approach.
7 We want to have all of our steps, whether it is
8 allocation of resources which issues we need to pay
9 attention to, which issues we should pour some money
10 onto, I want that to be done based on risk, truth and
11 risk, truth and harm to society so if frankly if one
12 issue seems to be hot because there are so many
13 questions but we see from the risk exposure that it
14 is not representing a whole lot of risk to us, we
15 really need to be careful with throwing resources at
16 it, so that's what I've done and that's what I am
17 doing and so there is a pattern and process here that
18 the R&D program hasn't fully meshed in how can we get
19 all the risk analysis that is being done in a
20 different, a different department in my office and
21 how could that risk analysis and the data analysis
22 and a more complete and better understanding of you

1 know, what we should worry about and how could that
2 then drive also some of the R&D agenda.

3 I am proud to have Lucy DiGhionno, on our
4 staff now she is managing and Lucy you will get to
5 hear her and see her today, Lucy is now running my
6 R&D program and I have full and complete faith in her
7 and her skill set and her abilities and I look
8 forward to her and her staff taking us into that
9 direction, so we need to be more risk driven and we
10 need to begin to craft our programs and allocate our
11 resources based on where the greatest risk is.

12 We are not there by any means to date but
13 I hope we can get there. We are not there because
14 the risk piece itself is not completely where it
15 needs to be but again I have a lot of good staff in
16 Felicia's group and Felicia herself working to help
17 us define that piece and I see Felicia sitting in the
18 back of the room.

19 Many inputs are thrown into the R&D
20 question industry needs, departmental needs,
21 perceptions by us and by the public and by you know,
22 and sometimes even it's not clear what made the

1 particular project a priority sometimes international
2 meetings may throw a challenge at us or require us to
3 look at something.

4 The accidents obviously clearly drive a
5 lot of the problems we look at, so it's fine and I
6 don't want necessarily to have single input, I think
7 it's appropriate for the R&D world to observe all of
8 these inputs. What is crucial for the R&D managers
9 is to work with the industry and work with the stake
10 holders and try to figure out - out of all of these
11 inputs, what should come out, what is the right
12 picture, what is the right distribution and what are
13 the specific topics we need to work with and that's I
14 think the challenge that we are trying to meet today,
15 that is why we invited you we want to show you what
16 we have done.

17 Please forgive us if what you think what
18 we have done in the past is not what we need to do
19 and factor again into your judgment that this was a
20 very small program run by one staffer only, or even
21 sometimes half staffer, half full time. We are
22 changing that we now have more staff dedicated to the

1 R&D question and we are trying to tie in the R&D
2 program to our mission and again I thank you for
3 indulging me this few moments this morning. I will
4 be here until noon if anyone wants to ask me or give
5 me any specific input, I will be gone at noon but I
6 may come back or not, depending on my time, but I
7 will try to come back if I could. Thank you so much
8 I appreciate it.

9 MR. PAQUET: Thank you Magdy, that ends
10 the only comment set that I will not interrupt, okay
11 if necessary, just putting that out there. So Carole
12 that leads to you, Dr. Carole LeBlanc, the Director
13 of Engineering and Research.

14 DR. LEBLANC: Thank you Ryan. I have the
15 best and easiest job today. I have seen the audience
16 and new friends, in particular from Canada, because
17 of TRB just finishing up. And old colleagues, not
18 chronologically old, mind you, but colleagues that I
19 have worked with in the past from folks from the
20 Department of Defense as well.

21 So all I am going to do is thank staff but
22 you know how that goes on and on but that's not the

1 case here. Besides thanking Mr. Paquet for being our
2 emcee, I would like to extend my gratitude to the
3 admin support staff that has done all of that
4 printing for you, for the while papers, we sometimes
5 forget to thank them. Miss Tanika Dyson if you bump
6 into her, tell her you appreciate that.

7 Then I would like to point out a couple of
8 key staff members, Dr. Kin Wong in particular, Kin if
9 you wouldn't mind standing. We are a very skilled
10 set of professional people but we are also tend to be
11 too humble and so I wanted to point out the wonderful
12 work that Dr. Wong has done with the Federal Asian
13 Pacific American Council, am I getting that right?
14 FPAC and that work in terms of promoting equal
15 opportunity as led Kin with recognition from the
16 department secretary and now all I have to do is
17 introduce Lucy to do and Magdy has already eluded to
18 the fact that she is our fairly new R&D chief.

19 We are delighted to have her in the
20 engineering and research department, division, excuse
21 me. Her previous positions include serving as a
22 senior technical advisor for the Department of

1 Homeland Security and as the lead for the U.S. Navy's
2 F35 chem bio program. Lucy comes to PHMSA with a
3 Bachelor of Science and Master's Degrees in chemical
4 engineering from Villanova.

5 Her major accomplishments also include
6 building a new hazmat manufacturing facility which
7 gives her a wealth of mechanical engineering
8 expertise as well so without further ado, Lucy.

9 MS. DIGHIONNO: Good morning everybody,
10 thank you all for coming to the inaugural event. We
11 are going to try to have this event every year so we
12 want to get a good feel for how you like this event.
13 Of course we are going to have a suggestion box, so
14 any ideas you might have for improving or things that
15 you like about the event, please let us know. Maybe
16 fill it out towards the end of the day so give us
17 your comments, if you want to be anonymous, be more
18 than happy to not put your name down, we just want to
19 make sure we mention that first and foremost.

20 I did check the federal register and I did
21 not receive any comments from you all so that was
22 what I was mostly going to cover today, is if you

1 have any comments regarding this presentation that we
2 are going to have today. So if you have comments
3 regarding the presentations let the presenters give
4 their presentation to you and then go ahead and then
5 ask your questions.

6 We did dedicate some time at the end of
7 the day to allow you to give us your comments
8 regarding our future work. Most of our future work,
9 but again also anything that we did cover towards the
10 beginning of the presentation so that is how we
11 structure this presentation today and again if you
12 think there is a better way that we have this forum
13 in future years go ahead and write it up.

14 Maybe that kind of item maybe that's best
15 to write in the suggestion box, the comments for the
16 suggestion box. I think that would be more of an
17 item to cover in that write-up, I think we want to
18 concentrate today on the projects that we are
19 presenting. The champions of these projects did a
20 wonderful job with these projects, but go ahead and
21 allow them to present these projects to you and ask
22 them your questions on either the work that they

1 performed or the work that they are currently working
2 on or give them your ideas on projects that we are
3 looking to perform.

4 Any Ryan if you could with this website
5 that we have created, if you go slide down and click
6 to R&D, research and development there at the left,
7 I'm sorry the right, all the way at the right, right
8 there. You slide down and you can see there is a new
9 link to R&D white papers. I don't know if any of you
10 have had the chance to look at that that was just
11 posted, right there, R&D, R&D, white papers right
12 there.

13 This is a new item that I just created, I
14 had most of the champions go ahead and write white
15 papers for projects so you wouldn't have to read a
16 long forty or sixty page report, because I know a lot
17 of you are very busy so you might like to read, if
18 you want to click on one of them if you like Ryan so
19 you could probably take the time to read a one to
20 three page report on some of these great projects
21 that these champions have worked on to give you an
22 idea on some of these projects.

1 Something that I had actually done at the
2 Department of Defense previous work so again you
3 could write that up and say I think that's a great
4 idea, if you don't like it or maybe you could change
5 the way it's formatted, we think it may be a good
6 idea if you add this to this topic, or modify it in
7 this fashion, so we would like to get your feedback
8 before I move any forward with this idea.

9 And at the end of this project today, we
10 are actually going to post all of our presentations
11 as well. We didn't want to do it until afterwards in
12 case we wanted to modify it in any way, in case you
13 thought well maybe we could change this in some
14 fashion. Any questions or comments, and I'll let the
15 presenters go ahead and present each project instead
16 of myself doing any kind of talking in that fashion.
17 So yes ma'am.

18 AUDIENCE MEMBER: Hi, it's a pre-recorded
19 meeting.

20 MR. PAQUET: Yes. So hi Cynthia, yes I
21 have a microphone and we are going to allow comments
22 afterwards, after each of the presentations but

1 please when you are giving your comments, please do
2 state your name and your affiliation so that Larry
3 here could capture all of that information for us.
4 Cynthia would you have a comment now because I am
5 going to keep you to a tight timeframe, okay. Hold
6 on, I am going to bring the microphone to you I want
7 to be close to you.

8 MS. DIGHIONNO: You knew he was going to
9 say that.

10 MS. HILTON: Okay Cynthia Hilton, with the
11 Institute of Makers of Explosives. So just generally
12 as we all know and we are thrilled that you have an
13 appropriation for FY14, congratulations, and a chart
14 was just released of the project that you are doing
15 so it looks like you have money that might not be
16 committed yet, so are you opening this forum to
17 receive ideas? I understand that we are going to
18 hear projects which are ongoing which is great and we
19 will comment.

20 MS. DIGHIONNO: And proposed projects. We
21 are looking, we are going to present to you proposed
22 projects, get your feedback on those proposed

1 projects, which we are looking at funding in the
2 future and we want to make sure and get your comments
3 on those projects before we move forward and go out
4 to bid.

5 MS. HILTON: Okay.

6 MR. PAQUET: No the comments, we are not
7 going to tell you to put in your comments but I will
8 tell you that we as human beings, we would like
9 positive comments too so if you have any of those
10 please provide us those.

11 MR. BARRETT: You are doing a great job
12 Ryan. Lucy, as far as, first of all the Hazardous
13 Materials Cooperative Research Program now is no
14 longer funded and I thought that was an excellent
15 program because industry and government could work
16 together and come up with ideas and were vetted to a
17 committee that was unbiased and objective, so now you
18 have this program, one question that maybe Magdy
19 could answer this better you know is what is your
20 perception of the HMCRP, is that something that you
21 would like to see funded in the future and then
22 secondly as far as ideas for research, if industry

1 were to submit these white papers or suggestions for
2 research that we thought makes sense to get some of
3 the risks and issues and cause safety concerns for
4 the public, how can they be submitted and how will
5 they be vetted in order to, how are you going to
6 determine which projects you are going to fund.

7 AUDIENCE MEMBER: May I make a comment?

8 MR. PAQUET: Did any of you read the
9 agenda? Is there a comment period right now?

10 DR. COVINO: I just wanted to make a
11 comment because I'm vetting and stuff, I'm Dr.
12 Josephine Covino from the Department of Defense and
13 one of the comments I have is that if you want to get
14 good ideas, the Department of Transportation, I think
15 that you should respect the proprietary aspect of
16 industry submitting proposals, so for example,
17 putting their proposals on a website, you know if it
18 is an idea you need, you should respect that and I
19 don't know how you want to handle that, I don't know,
20 everything is open forum but I think that there are
21 some limitations and I think it would go a long way
22 in getting some very good ideas.

1 MR. PAQUET: I don't know if right now is
2 an appropriate time to talk about HMCRP or any
3 comments on that but you can certainly track down
4 Magdy or anybody else. As for, and I'm just you know
5 the Approvals and Permits Division Director so, other
6 people are in the room, but I am pretty sure that we
7 are open to comments, we want to know what's going
8 on, we want to know all of your comments, all of your
9 suggestions, this is why we are here today please
10 feel free to make short comments today, up until the
11 afternoon anyways and then provide us comments both
12 either to the docket or directly to Lucy after this
13 forum is done.

14 And again comments on how the forum was
15 run and what we can do next year you know, whether it
16 should be two days next year, there is all kinds of
17 ideas that we have heard already this morning so we
18 welcome those as well.

19 All right so we are going to start, we
20 are going to start right now with Joe Nicklous, the
21 Chief of the Sciences branch.

22 MR. NICKLOUS: Well thank you for all of

1 the introductions from Magdy, Carole, Lucy, Ryan and
2 thanks to everybody for coming. I am hopeful that
3 this is a positive day and there are positive
4 outcomes from it and I think it's just a learning
5 experience in how to run it and how to get it going.

6 As everybody has already said all of the
7 comments are going to be appreciated and looked into
8 and taken so without further ado I drew the short
9 straw and get to make first presentation so try not
10 to beat me up too much, thanks Ryan.

11 So we started the research project within
12 the UN manual testing criteria, the UN 6c test is
13 more informally referred to as the bonfire test.
14 There are multiple ways of conducting the test, set
15 up and procedure. Typically what is used within
16 multiple, within all the different test facilities in
17 the U.S. and around the world, is either wood fuel or
18 liquid fuel for the bonfire.

19 We decided there is a section in the regs
20 or in the manual testing criteria that describe what
21 a propane or gas fed fire would look like and need to
22 be able to produce for that test. So we set out to

1 figure out how to set up this type of a fire and how
2 to describe it so that others may potentially use it
3 down the line.

4 So first question why develop a gas fed UN
5 6c test assembly? First it's a lot easier to sustain
6 a constant temperature of 800 degrees c which is the
7 criteria within the manual. Typically the cleanup of
8 a wood fuel fire or liquid fuel fire is a rather long
9 labor intensive gas fire you can kind of just shut
10 off the valve, let it cool down and then just clean
11 up the product, not necessarily all of the fuel as
12 well.

13 You get to shut off the fuel when the
14 reactions are complete, typically there is a little
15 bit less cool down time when you associate a gas fed
16 fire. Liquid and fuel, wood fuel typically gives a
17 little bit more thermal radiance and your surrounding
18 area will get hotter you have to apply water into the
19 wood fuel or a suppression agent to the liquid fuel
20 to stop the reaction and it would just create a
21 bigger mess.

22 Fuel savings potentially at least right

1 now I believe the gas cost is a little less than some
2 of the other types of materials and a little bit more
3 environmentally friendly. So as I said there is a
4 description of what this fire would need to do and
5 look like in the UN manual testing criteria the
6 chapters and paragraphs are up listed up there.

7 The set up that we used approximately
8 covered two and a half square meters and was
9 fabricated completed out of carbon steel inlets for
10 gas at either end of the running pipes of gas feed
11 underneath of the product when you test it. And we
12 also wanted to determine the number the minimum
13 number of cylinders necessary to achieve a thirty
14 minute fire which is what is described as what is
15 needed in a maximum scenario.

16 Obviously, if all of the product reacts
17 prior to thirty minutes, you can shut it down
18 beforehand and not consume as much fuel.
19 Experimentally we determined that there were twelve
20 cylinders that would be needed and they would need to
21 be sufficiently surrounded by a water bath to
22 maintain the temperature of the tanks to keep the

1 flow steady enough to sustain that fire for the two
2 and a half square meters.

3 That's a photo of the test setup, I don't
4 know what else to really describe. Two and a half
5 square meters, you have the test grid on top, the
6 four vertical pipes if you will are doing nothing
7 more than holding thermal couples to determine that
8 the temperature is being sustained, sorry, the
9 temperature is being sustained above the fire and
10 that's really all that is showing so the first test
11 that we did and let me just sidebar real quick, there
12 was multiple tests that were done to determine what
13 those, the number of cylinders that are needed. We
14 eventually got to the point where we could sustain a
15 thirty-two minute test and it could have kept going
16 quite frankly. We recorded that test two different
17 methods, a regular video camera and a high speed
18 video camera. We did achieve a constant temperature,
19 approximately constant obviously there was always
20 going to be a little up and down of 800 degrees c for
21 the entire time.

22 The total consumed materials is 8.3, 8.4

1 kilograms per minute for the fire itself which works
2 into .7 roughly per cylinder just to elaborate on
3 that, in theory you could conduct this with a fewer
4 number of cylinders based on the consumption however,
5 given the rate and the cool down effect of the
6 cylinders in order to sustain that 800 degrees for
7 thirty-two minutes the twelve ensured that that
8 product or the propane fed the fire, didn't ever
9 shut itself off to do the cool down effect so you can
10 tweak the number of cylinders that are used, you just
11 have to increase the water bath around the cylinders
12 to keep the cylinders producing the propane fast
13 enough.

14 So there's a photograph of the propane
15 assembly it just shows a nice clean burning fuel
16 relatively familiar to any of those in the explosives
17 industry that have seen a 6c test, obviously a little
18 bit different, you don't have a pan for liquid or a
19 big stack of wood underneath.

20 So after the proof of concept if you will,
21 the thirty-two minute test that we did, we decided to
22 do a demonstration test. We just wanted to show some

1 of the other potential side benefits of running tests
2 in this fashion as opposed to the other two more
3 commonly used. We took two packages of a propellant
4 commercially available, each of those packages had
5 two inner packages containing roughly eight pounds of
6 powder.

7 One was placed in a single wall, one was
8 placed in a double wall, they were placed in a test
9 stand, exposed to the propane fire and we also
10 instrumented the fire with thermal couples
11 radiometers at various distances which kind of mimics
12 some of the criteria in the 6c and during this test
13 again, this is not a full 6c test, it was just a
14 proof of concept if you will, a demonstration that
15 shows some of the other side benefits like I said,
16 but just as a side note, none of the, during this
17 test there was no experience of a four kilowatt at 15
18 meters, just a nice little side note.

19 Again, there are no real conclusions
20 there, solely because it wasn't a full 6c scale up,
21 there wasn't any witness screens or anything along
22 those lines, it was just a demonstration.

1 So in summary, these were some of the
2 other side benefits, some of them I've already kind
3 of talked about. Cleaner burning it doesn't give you
4 as much smoke as the liquid fuel, it doesn't give you
5 as much smoke as the wood fuel either, and it also
6 gives a little bit better environmental impacts. You
7 can shut it off, you don't have to throw extra just
8 to make sure the fire is going to continue long
9 enough to react to all the product, much cleaner
10 burning, typically you could probably see the
11 reaction is a little bit clearer, you don't have that
12 smoke again.

13 The thermal irradiance from a gas fed fire
14 is typically more constant and is less than either
15 wood or liquid fuel and since you can extinguish it
16 easily after everything has been reacted to the fire,
17 there are some cost savings, given the fuel
18 consumption as well as the ability to quickly run
19 back to back tests due to that cool down that I
20 mentioned earlier and that's really all I have about
21 the tests that we have done so if there is any
22 questions and or comments.

1 Oh, sorry Cynthia, Magdy did remind me,
2 next step. This is going to be, we have already given
3 an introductory paper to the last UN SCOE TTG meeting
4 basically saying that we have conducted this, that
5 there is a paper that is going to come this will be
6 presented at the Igus EPP meeting as well as the next
7 summer session of the subcommittee of experts on TTG.
8 Again this is just an option for test labs to us, not
9 necessarily a mandate it is just letting people know
10 that the feasibility of setting up and carrying out a
11 gas fed fire in lieu of the traditional wood or
12 liquid fuel, just an option, so.

13 MR. PAQUET: All right so this is our
14 first foray into comments, I did see a hand go up, we
15 have ten minutes for brief comments and then we will
16 have some opportunity later in the afternoon so if
17 you don't get to say everything remember that.

18 MS. HILTON: Okay hi Joe, thanks.

19 MR. NICKLOUS: I need your name Cynthia.

20 MS. HILTON: Hilton, Cynthia Hilton,
21 Institute of Makers of Explosives. We are very
22 interested in this project and so we wanted to know

1 and I also want to relate it because later on there
2 is supposed to be a presentation on the bonfire
3 testing, and information that we got from the
4 department yesterday doesn't list this as a project
5 so let me try to narrow this down to a couple of
6 questions for you.

7 I am still confused maybe I'm the only
8 one in the room, it sounds to me like work has been
9 done but it is not reflected on or is it on this
10 table and I just don't know what you are calling it
11 but it is already on this table, one, two, when you
12 get around later today and you have the presentation
13 on the bonfire test is this like a part of that
14 larger study?

15 Three we are really thrilled that you are
16 doing this kind of investigation we are totally
17 supportive of that. We wrote Carole a letter back I
18 think in September telling her how important this
19 stuff is so we would encourage you to continue this
20 work and the last question that our guys want to know
21 is, is this like an authorized way of doing things
22 now, I mean they really like for all the good reasons

1 that you said and the ability to use this option in
2 testing, they wonder if you have more specific
3 information like numbers of burners okay you get the
4 idea.

5 MR. NICKLOUS: All right I will try to
6 address them very quickly. Yes it is authorized now,
7 like I said it is described in the UN manual testing
8 criteria. Yes there will be more detailed
9 information like I said it will be presented to the
10 Igus Committee, EPP as well as the subcommittee of
11 experts. That paper will contain all of the
12 engineering diagrams and everything else that you
13 would need to basically mimic this test.

14 Again, it is already authorized, it just
15 it hasn't been widely done and there are some
16 technical reasons why it hasn't been done because it
17 is a difficult setup to sustain that combustion for
18 that long of a period of time. I apologize I don't
19 know exactly what table you are talking about but we
20 can update that if it is not accurately reflected and
21 yes it does kind of feed into the larger study but
22 you will hear about that later. This was just one

1 that's kind of already been completed and is getting
2 ready to be presented which is why it is kind of
3 first on the list.

4 MR. BARRETT: Hello Ryan, thank you. I'm
5 Bill Barrett, Sporting Arms and Ammunition
6 Manufacturers Institute, otherwise known as SAAMI.
7 Hello Joe, thank you for this presentation and the
8 work that you have been doing. I think everyone is
9 interested in doing technical improvements to the
10 methodologies for improving the test, and I know that
11 PHMSA has already presented this at various forums
12 and other countries also have some input I think that
13 could be of use.

14 One thing that we are concerned about as
15 we looked at this research and also the 6c
16 improvement project that is going to be brought up
17 later I think, is that we support general research
18 that will produce facts which they can be assessed
19 and reactions can be taken.

20 But what we've been concerned about, and
21 we are especially concerned to see it again in this
22 test, is that that in the other project, is said it

1 was improving the whole test but it was specifically
2 only tested smokeless powder in very confined
3 scenarios and this again deals with smokeless powder
4 and we just wish to note that the UN manual testing
5 criteria is specifically non-prescriptive, it does
6 not lend itself, just prescriptive enforcement and
7 specifically says that it must be interpreted by
8 experts otherwise the results will not be valid so we
9 support the work but we would be leery of seeing it
10 focus on one particular product and draw conclusions
11 which may later color people's thinking on how
12 allergic their product is classified when if you
13 tested other products you may see that they cleanly
14 fit within the boundaries, thank you.

15 MR. NICKLOUS: Yes, thanks Ben, like I
16 said we took a commercially available product and it
17 was just more of a demonstration of the test
18 assembly. It wasn't trying to draw any conclusions
19 regarding the final classification of that, it is
20 literally just to communicate the ability this type
21 of a set up to meet the description within the UN
22 manual testing criteria for labs worldwide.

1 I mean I completely agree with you that
2 you know we want to base it upon facts we just want
3 other people to be able to see how to set up and run
4 this particular style of test, for some of the side
5 benefits as I have already kind of noted. Not
6 necessarily going back and reinventing the wheel of
7 all the different classifications, you know I think
8 it would be beneficial to see some of the test sites
9 potentially utilizing this and seeing if there are
10 potential changes to the classifications.

11 Maybe this makes it a little bit easier to
12 determine when things are on the borderline cases.
13 But again it's just a set up procedure. It doesn't
14 necessarily have to go into the UN we just want to
15 share the setup, the test apparatus so that other
16 labs could potentially utilize it.

17 MR. SMITH: Hi, I'm Greg Smith, one of the
18 principal investigators, a principal investigator on
19 one of the current HNCRP projects and I have a more
20 technical question, a sort of curiosity. It seems to
21 me that you have done a very good job of designing a
22 test that uses propane to mimic an actual burning

1 fire and I am curious if the fire element is critical
2 or if you are simply wanting to achieve the
3 temperature indicated because if you are simply
4 looking for the temperature, you might be able to
5 create a slower moving forced air flow of hot gasses
6 with a control burn and use that to achieve the
7 temperature instead of really quite a large amount of
8 fuel, and so I'm just curious if you have considered
9 that or if there is the need for a natural fire is
10 critical.

11 MR. NICKLOUS: Thank you. Off the top of
12 my head no that hasn't been considered and I can
13 definitely have this in depth conversation with you
14 subsequent to this if time starts to cut short Mr.
15 Paquet. But within the UN manual there are three
16 setups, three different options that are per
17 described, I won't say prescribed but described. The
18 liquid fuel fire, the wood fuel fire and a gas fed
19 fire. This criteria, pretty nonspecific criteria
20 that need to be met, thirty minutes, 800 degrees c,
21 then it tells dimensions, there's not much more than
22 that.

1 To add another option of a style of test
2 would probably take, actually let me rephrase that,
3 it wouldn't take a change to the manual because you
4 could always run a new type of test based on a
5 competent authority's decision, so things along what
6 you are describing are definitely an option. They
7 have not been considered yet and I think it would be
8 something to undertake, but it would be starting from
9 something that hasn't been considered before, it
10 would be much broader, deeper, bigger, longer type
11 research and if there are potential benefits to it,
12 it's something that I think we should consider and
13 you know if you have any ideas the write up would be
14 great.

15 MR. PAQUET: Thank you. There are no
16 other comments on this so we are going to move on.
17 So good job guys, eight minutes and thirty-three
18 seconds, see we can do it. I was a little leery, I
19 didn't know if we could but we can so. Just trying
20 to get everybody out on time, so our next
21 presentation is about nurse tanks and, oh here's
22 Leonard, great, Leonard Majors.

1 MR. MAJORS: Good morning. My name is
2 Leonard Majors, I am with the Engineering and
3 Research Division, I am engineer with the engineering
4 branch here to present the nurse tank safety project.
5 The project was a collaboration between the
6 government, FMCSA, is David Goettee present? David
7 Goettee he was responsible for the FMCSA piece of the
8 project, James Simmons and I represented the PHMSA
9 aspect of it. We also have Virginia Tech, Iowa State
10 University also we had many industry partners, such
11 as Trinity and some of the builders that were also
12 peer reviewers of the project as well.

13 The study was conducted in two phases.
14 Phase one was December 2008 until May 2011. During
15 this phase we were trying to get an idea of how to
16 examine the tanks, if there was a stress corrosion
17 cracking, crack growth rate and we tried to do some
18 computer modeling in that first phase.

19 Phase two began in October 2010 to August
20 2013. We wanted to know did pinhole leaks cause
21 certain ruptures, certain failure of the tanks. We
22 also wanted to know the effects of stress leaving or

1 a possible heat treatment. We did a survey of five
2 hundred tanks of ultrasound in the wells and also we
3 did another, we wanted to go deeper into the stress
4 corrosion cracking and study specimens in three
5 conditions.

6 As some people in the room may know we
7 have nurse tanks that have been in service since the
8 60's, they are still being used to the day. There
9 are no testing requirements as of yet, that was part
10 of the study for us to come up with this. We do have
11 testing requirements for nurse tanks that are missing
12 the ASME plates. As you can see if you get a large
13 enough crack, this is the result.

14 For the pinhole leak aspect of the
15 project, we just wanted to ask a couple of questions.
16 What causes pinhole leaks and can a pinhole leak
17 cause the effect that you saw on the previous slide.

18 What causes pinhole leaks is weld
19 veracity. That means your welding, where the weld is
20 wet that could have rust, some kind of contamination
21 in the well. We found that it is very unlikely that
22 a pinhole leak could cause to set in the failure that

1 you saw earlier in the picture.

2 Phase two of the study as I spoke earlier,
3 we had two hundred sample of leaks, divided them up
4 into three environment samples. Half of the samples
5 were in the vapor space, half were in the liquid and
6 these samples were put intense stress in a range from
7 25 to 95 megapixels.

8 These are the three environments, and
9 hydrous ammonia and hydrous within serve and you know
10 we vacuumed the tank and tried to create a pure
11 nitrogen environment and hydrous.

12 The findings, we noticed that the purged
13 in or any of the cracking that we saw in serve didn't
14 cause more cracking but we saw that it has some
15 corrosion effects. And we kind of found out that
16 some recommended inspection terminals could be
17 calculated based on what we saw from the specimens.

18 Stress relieving, basically after you
19 complete your wells, you put it in the over you raise
20 it to a temperature and it relieves the effects of
21 the welling process in the heat affected zones and we
22 tried to use the technique that is going in the next

1 slide to see if we could measure how much the
2 reduction of the stress would be.

3 This is a picture from Los Alamos, they
4 did neutron diffraction in the weld area as you can
5 see this weld is way joined as shell to the head,
6 that is the high residual stress and that is where
7 the analysis was performed. We saw the residual
8 stress was lower by thirty percent on average. We
9 used stress relieved on the nurse tank itself and we
10 found out that when you use stress relieve you get
11 less cracks.

12 This is going to the tank survey, the
13 students at ISU were trained in the EDE methods,
14 using angle beam ultrasonic base, they had a
15 procedure where they had to inspect all the wells,
16 seam wells, surface oil commercial wells, wells on
17 the lakes that adjoin nurse tanks to a chase. Only
18 nurse tanks with legible plates and tanks that we
19 could get data from all those, those were the only
20 ones considered.

21 It typically took two to four hours to get
22 around the tank. Some of the results you know as you

1 can see ninety percent of the indications that we
2 found were in that well from head to shell mostly in
3 a perpendicular plane and what we found out was that
4 pinhole leaks are not critical to the tank, you know,
5 we found out that stress corrosion cracking happens
6 mostly in the break area, also post loyal heat
7 treatment can reduce the stresses and reduce the
8 cracking.

9 And as mentioned before most of the
10 indications were found in the heat effect zone,
11 eighty-four percent of the indications were in the
12 heat effected zone and most of the, well it will be
13 in there but most of the younger tanks from 1999 or
14 after, because there are different types of
15 materials, thinning steels, we found more indications
16 in those than the older tanks.

17 That concludes my presentation.

18 MR. PAQUET: All right so now is the time
19 for questions on this topic.

20 MR. CONLEY: Good morning, my name is John
21 Conley, Artist formerly known as President of
22 National Tank Truck Carriers. Two questions, have

1 you developed some information that can be used in
2 also looking at MC331 cargo tanks that are in this
3 type of service and secondly did you look at all or
4 have you been watching at all the performance of
5 these tanks in the shale oil field environment?

6 MR. MAJORS: We have not particularly
7 looked at the shale oil field environment but we do
8 know that some of the materials that are pulled out
9 of the shale would be consistent with hydrous ammonia
10 effects but we haven't officially looked at that
11 aspect of it.

12 Going to the MC331, we were trying to
13 separate the two because the MC331 you have testing
14 and inspection criteria already so we were trying to
15 focus on the nurse tank aspects so we can try to
16 bring it up to that level.

17 MR. CONLEY: Thank you.

18 MR. GUPTON: My name is Richard Gupton,
19 I'm with Agricultural Retailers Association and I
20 have I guess several questions. The first question
21 would be I think you said you reached out to some of
22 the private industry you mentioned Trinity who makes

1 tanks. I saw listed, was Dow part of those studies
2 as well since they are the maker of the product, sell
3 their product?

4 MR. MAJORS: I don't know specifically if
5 they were involved, they may be indirectly involved
6 so I couldn't tell you that.

7 MR. GUPTON: The other question is you
8 mentioned some students take five hundred and thirty
9 some tanks, how did you select the tanks? How were
10 those, you know how was that process, which tanks you
11 decided to test?

12 MR. MAJORS: Well as stated in the
13 presentation we wanted to keep the nurse tanks to the
14 legible plates, plates that had data plates, but most
15 of them were done at the Iowa co-ops in the area
16 around the university.

17 MR. GUPTON: So you went into the local
18 co-ops, you went there and got their volunteer
19 participation?

20 MR. MAJORS: Yes.

21 MR. PAQUET: Great. Any other questions
22 James?

1 MR. SIMMONS: James Simmons, PHMSA. I
2 just want to express the gratitude to the industry as
3 well as the CSA all in the development of this
4 project. This particular project involved a lot of
5 universities and students and demonstrates industry's
6 cooperation not just with CSEN but PHMSA so this is
7 an example of what we have previously they also might
8 have mentioned about the collaboration across the
9 board. This is also the model that we can look
10 forward to using to allow our future research to be
11 developed so I just wanted to explain that and thank
12 you as well to you all for that process.

13 MR. O'NEIL: John O'Neil from Nortico.
14 The question is regarding the ultrasound, I
15 understand it was students, were they qualified and
16 certified or are they just inexperienced students?

17 MR. MAJORS: Well Iowa State has a
18 professor who has experience and he was overseeing
19 the students and he trained them personally so.

20 MR. O'NEIL: Okay the other comment I had
21 was I just want to say that there is no depth sizing
22 technique available, that's incorrect. It is used

1 regularly in the nuclear industry and my question
2 was-was there any attempts made to have depth
3 measurements that you achieved?

4 MR. MAJORS: We were more concerned with
5 crack leak and crack propagation more than depth.

6 MR. O'NEIL: Aren't they related though?

7 MR. MAJORS: Yes they are related but for
8 the focus and the aspect of this and the timing of
9 the project we weren't able to go into the depth
10 aspect of it. That was something that was discussed
11 in a future phase but we are actually discussing what
12 efforts, what will be the next phase so, correct
13 depth is something that we were aware of.

14 MR. O'NEIL: And so if you have some
15 understanding.

16 MR. MAJORS: And we are open to
17 suggestions on.

18 MR. O'NEIL: Some suggestions on how we
19 can do that please.

20 MR. PAQUET: Exactly. All right, well
21 done again, you guys are making me so proud. Great
22 time so let's go ahead and take a twelve minute break

1 since this ended a little bit earlier than normal,
2 trust me I will start in twelve minutes, restrooms
3 are over there in that corner and the coffee shop is
4 right out here to the left.

5 MR. PAQUET: All right so our next
6 presenter is the same as the last presenter, Leonard
7 Majors, cargo tank rollover special study, so ahead,
8 you are on the clock.

9 MR. MAJORS: Good morning again I am
10 Leonard Majors and I am here to talk about the cargo
11 tank rollover study. Rollovers are you know,
12 approximately twenty-two percent of all HM crashes
13 involving cargo tanks. According to the FMCSA study
14 you know we found human drivers are the number one
15 contributor to rollovers.

16 What we propose to do in our research is
17 to determine the impacts of the rollover video that
18 was produced by FMCFA. We would like to know has
19 that any effect on driving behavior, has any incident
20 reduction occurred, do we need to go further with
21 outreaching with that video.

22 Also what we want to look at the train

1 requirements in the 49CFR to determine if there is
2 any additional you know measures that we can take at
3 PHMSA to improve and reduce the number of rollovers.
4 Also we want to research and probe the industry to
5 see what training requirements are, what training
6 policies are that you have that we could piggyback on
7 or highlight to have an effect on rollovers.

8 And in addition we did a survey over a
9 year, we started in October 2012, we are looking at
10 rollover incidents base week, any rollover incident
11 that occurred in the one year period we were
12 collecting data on it and trying to find out you
13 know, speed, road conditions, weather conditions and
14 we were trying to determine how we can pursue what
15 the driver experiences, thank you.

16 MR. PAQUET: Before I see if there is any
17 comments, I just want to make some clarifications
18 now, we are on the ongoing parts of the research and
19 development projects, the ongoing projects and then
20 later on today we will start talking about proposed
21 ones so if it seems a little shorter than the first
22 one, that's why because they are ongoing.

1 Also you can see on the agenda we use the
2 words contain, communicate and classify because that
3 is the three c's of the hydrogen regulations.

4 Classify, contain and communicate and there are some
5 other c's and we will talk about those. Anyway, I
6 will open it up for questions.

7 MR. CONLEY: John Conley, a question
8 first, I read through the white paper, I retired a
9 long time ago, two weeks, and there's a statement
10 here that I want to make sure that we are using the
11 same language. It says during the first and second
12 quarters of fiscal year 2013, there were a total of
13 thirteen incidents involving death or injury. Was
14 that death or injury because of the crash or because
15 of the hazardous material?

16 MR. MAJORS: Where it says here it was in
17 the first quarter. We are still trying to you know
18 go back and get coroner reports on the incident, more
19 data on the incident and that number may be a little
20 high or it may be a little low.

21 MR. CONLEY: I would suggest for all of
22 our sakes, the agencies, the industry and everybody

1 else's, any time that a number like that is used that
2 we break it out because we know that there is not
3 probably thirteen deaths for hazmat a year. So I
4 think it would be good for everybody, your
5 contractors, yourself, and industry to point out the
6 number of deaths from the hazmat, since this is a
7 hazmat study, just an observation that I think would
8 help all of us, thank you.

9 DR. COVINO: I know you didn't think I
10 was going to say anything. I'm Josephine Covino of
11 the Department of Defense. The question I had on
12 rollovers, I would encourage you to measure all of
13 the mechanical turbulence in that rollover. Mostly
14 understand the shock loading that you could have
15 inside the truck and the reason being that we within
16 the Department of Defense have evaluated our
17 commodities and how we, what the rollover frequency
18 is and what the drops is so thus giving what the
19 shock loading would be to our systems.

20 That number goes a long way in helping us
21 improve the classification process and it would be
22 nice if you get an independent value on that number

1 from and I could talk to you on what the numbers are.

2 MR. MAJORS: Okay thank you.

3 MS. HILTON: Cynthia Hilton, Institute of
4 Makers of Explosives, we all know what a cargo tank
5 is but I just want to make sure that this project is
6 limited to articulated vehicles, the reason I am
7 asking is that a couple of years ago straight trucks,
8 there was a lot of discussion about stability control
9 and our straight trucks we provided the department
10 with a lot of data about our relative center of
11 gravity. We operate most of the off-road conditions
12 which are very unstable to roadways and so we just
13 want to make sure that you are just looking at cargo
14 tanks right now, you are not looking at straight
15 trucks.

16 You are when you are talking about
17 stability control and I don't want you to answer
18 John.

19 MR. SIMMONS: Well twenty-five percent of
20 cargo tank rollovers are straight trucks. That's a
21 problem.

22 MS. HILTON: Why do you have the

1 microphone?

2 MR. PAQUET: Because you handed it off to
3 me.

4 MR. SIMMONS: As we all know cargo tank
5 rollovers have been with us for quite some time. We
6 are taking a serious of steps including video
7 training including a study that was done in 2009 and
8 the results of at least that particular study,
9 identify that drivers contribute to these rollovers,
10 that's number one, the majority of them.

11 Number two is that yes there are other
12 things in that study that we did previously, that was
13 related to the electronic stability of those great
14 road designs and different things of that sort. We
15 want to focus on primarily, is those contributable
16 actions of the driver. Now TRV has provided us a
17 study and John I believe you were a part of that with
18 the role of human factor in preventing cargo tank
19 rollovers so what I believe we are trying to pursue
20 is the opportunity of looking at the driver's piece
21 in this.

22 The electronic stability and other aspects

1 of the cargo tank itself is within another
2 department. Our friends at NHTSA are making some
3 headway on that so what we want to do is focus on the
4 ability as it relates to the training of the driver.

5 MR. PAQUET: All right any other questions
6 about this ongoing project? I will just point over
7 to this front table here, well thank you Leonard.

8 MR. MAJORS: Thank you.

9 MR. PAQUET: All right, sorry that was
10 definitely I meant Mark.

11 MR. TOUGHIRY: Good morning. As you know
12 the time is limited, they told me no opening jokes,
13 no introduction, perhaps most of you know me but I am
14 going to introduce my name anyway, I'm Mark Toughiry,
15 the old timer at Hazmat, engineer of research. The
16 subject of my presentation today is just emission is
17 an ongoing project that started with the Department
18 of Defense Navy with the collaboration of PHMSA
19 engineering department and its ongoing and the
20 collaborator for the ongoing project is basically all
21 of the municipal fire stations in the United States.

22 I would like to personally thank and

1 appreciate all of that was donated for this ongoing
2 project that we have. Let's get exactly to the
3 content of the project and what are the objectives of
4 us doing this kind of project.

5 I am sure most of you know that
6 self-contained breathing apparatus these are commonly
7 called air cylinders, these are the cylinders that
8 fire fighters put them on the back to fight the fire.
9 Traditionally they were steel cylinders, lately for
10 the past twenty years or so there is a wide usage of
11 these cylinders that are made from composite
12 structure and that I am going to tell you what we are
13 trying to achieve from this project.

14 Number one we want to assess the cylinders
15 to see how safe these cylinders are when they are
16 reaching the end of their fifteen year shelf life
17 which was originally designed for these cylinders to
18 be used.

19 Number two basically we thought that since
20 we are doing a lot of destructive testing, we are
21 doing a lot of performance testing, let's now try a
22 non-destructive testing and see if this technique

1 could protect the cylinder well ahead of its failure
2 so for this project we are doing physical testing and
3 non-destructive testing.

4 Briefly I describe what these composite
5 cylinders are that I am referring. The most commonly
6 used composite cylinders in the United States and
7 perhaps in the world are the composite cylinders that
8 are fully wrapped with carbon fibers and most of them
9 are metallic liner and most of them are aluminum
10 liner. With that DOT has established DOT CFFC which
11 stands for carbon fiber fully wrapped composite
12 cylinders with reinforced aluminum liner commonly
13 called DOT CFFC.

14 The cylinders there has to be a composite
15 cylinder that we are talking about are usually most
16 of them are 6.9 liter volume, they are designed to
17 last forty-five minutes, service pressure is 4,500
18 psi which as you know is pretty high pressure and
19 they are designed to be used for fifteen year service
20 life. Liners are made out of aluminum 61 t6 and the
21 shell is commonly carbon fiber with resins in the way
22 of glass.

1 There is a safety factor for these
2 cylinders which is 3.4 simply is the ratio, burst
3 pressure over such pressure. As I mentioned we have
4 performed two types of testing, mechanical testing is
5 simply what we have developed this mechanical testing
6 to be, to take an old cylinder and treat it as a
7 brand new cylinder. We have applied all of the
8 testing that are required to qualify a brand new
9 cylinder to go into service for fifteen years.

10 And parallel to that mechanical testing,
11 we have also applied nondestructive testing.
12 Mechanical testing for design qualification of
13 cylinders which will either reach the end of fifteen
14 years or they were very close to the end of their
15 fifteen years, includes burst testing, fatigue
16 cycling testing, flaw testing and drop testing. If
17 there are manufacturers among us these are basically
18 all of the fundamental testing that are required to
19 qualify a brand new composite cylinder.

20 This is a typical burst testing and it is
21 set up for fatigue and cycling testing which
22 basically the fatigue cycling testing we started for

1 100 psi and brought the upper pressure to status
2 pressure at 65 degrees centigrade or 149 degrees so
3 it was the developed pressure of the cylinder.

4 This is a flaw test assessing which simply
5 we took some of these cylinders we damaged them on
6 purpose to measure damage and then put them in tests
7 to see how they last.

8 This is a typical drop testing, which
9 basically met all of the, we tried to duplicate the
10 brand new cylinders and also pushed the envelope a
11 little higher by increasing the height and the
12 weight.

13 Two nondestructive testing were applied on
14 every one of the cylinders during this mechanical
15 testing, or strain gauging, but basically were
16 measuring the stress, applied the stress on the
17 cylinder during the puncturization and also a
18 parallel applied non-destructive testing called
19 mortar during the initial testing.

20 This is a typical straight aging set up
21 and basically if somebody would ask what is more than
22 the configuration testing, this is a fairly new

1 technique, the principal of this testing starts from
2 acoustic emission testing, which has been used in the
3 United States across the board for over twenty years.
4 This is just the typical set up, the stressor set up
5 on the left, on the right the result of the cylinder
6 which has defect and predicted to be failed before it
7 makes any burst pressure.

8 Conclusion, by the completion of this
9 recent project we are hoping to get the following
10 conclusion. Whether or not this CVA, DOT CFFT
11 cylinders could safety be used beyond fifteen years.
12 Secondly how could we apply this modern configuration
13 during the de-qualification to detect any unseen
14 problem that occurred during the operation, with that
15 I go straight to the questions.

16 MR. PAQUET: All right, who's up, yes?

17 MR. HOPKINS: Richard Hopkins,
18 International Association of Firefighters. As you
19 are talking about forty-five minute cylinders are you
20 doing any testing with thirty minute cylinders and
21 sixty minute cylinders?

22 MR. TOUGHIRY: The answer is additionally

1 no. That is exactly why we picked forty-five minutes
2 to basically stay in between and to see if the result
3 would be a little more relevant across the board.
4 Also as far as I know forty-five minutes are the most
5 commonly used cylinders.

6 MR. HOPKINS: There is still quite a few
7 fire departments that are using thirty minute
8 cylinders and Hazmat sixty minute cylinders are out
9 there in use as well.

10 MR. TOUGHIRY: So are you concerned that
11 the data may not be applicable to thirty-minutes?

12 MR. HOPKINS: Yes, I am just wondering
13 again if something like the drop test, if there would
14 be any difference you know between the size of the
15 cylinders as far as the way it would impact, and are
16 you looking at the move the cylinders maybe as far as
17 maybe any heat that they have been exposed to on the,
18 that you could tell from, you know the outside of it?

19 MR. TOUGHIRY: Yes, thank you, that is an
20 excellent question. We are looking at the cylinders
21 which when used for close to fifteen years in all
22 kinds of conditions so the cylinders you are getting

1 in your shop for testing, there is a large number of
2 samples we are testing, could be any of the above and
3 we also of course, we identified the cylinders before
4 we put them into this mechanical testing to see what
5 type of problem it has.

6 First of all to see if modern testing
7 could detect the problem, second if that heat
8 affected area, dropped area or cut area actually
9 impacted its service life and how did it affect it.

10 MR. MILLER: Good morning, thank you.
11 Richard Miller, International Association of Fire
12 Chiefs. First of all I would like to say thank you
13 very much for doing this study and having tried to
14 coordinate getting you the bottles, I am going to
15 continue to do that for you so that the study goes
16 on. Is the power point going to be available to
17 start distributing to show some of the people that
18 have helped contribute bottles what is going on with
19 the process?

20 MR. PAQUET: Yes. All of the
21 presentations that you see today will be available on
22 our website shortly, probably within the next week or

1 so, we are going to finish them up.

2 MR. TOUGHIRY: Absolutely, we need to make
3 sure, if we haven't already all of the folks that
4 helped whether they are helping, gave these samples,
5 the folks who donated samples, we need to get copies.
6 We already have the list and we have asked for their
7 names and thanks everyone.

8 MR. CONLEY: John Conley, very quickly
9 just a comment as much as anything else, but the two
10 gentlemen from IFC and myself, the carbon tank
11 rollover video that was mentioned earlier we have
12 come up with another version of it, working with the
13 DOT where we have like a two minute introduction to
14 firefighters, for firefighters, because we are seeing
15 way too many firefighters killed or injured in cargo
16 tank rollovers.

17 Using your resources and the gentlemen
18 from IFC they are free, you can down load them.
19 Anybody we can get them out to, we have sent out like
20 seven hundred, our national tank has sent out like
21 seven hundred, but we can save some lives I think.

22 MR. TOUGHIRY: Thank you.

1 MR. WERT: Jack Wert with the Compressed
2 Gas Association. Mark if you could two quick
3 questions. Has this research been completed on the
4 ability to re-qualify these composite cylinders to
5 actually be able to make that assessment?

6 MR. TOUGHIRY: Let's see if I understand
7 your question Jack, are you saying that are we
8 assessing more than the configuration to be used for
9 assessing cylinders for additional service life, is
10 that the question or not?

11 MR. WERT: Well not just the mobile
12 acoustic emission but the whole package that you
13 listed, you are going to do the study based on first,
14 and after you looked at all that data, if it passed
15 that criteria, then you were going to apply MAE and

16 MR. TOUGHIRY: Not the straight gauge, it
17 would not be applicable.

18 MR. WERT: Have you got to the point that
19 you feel you can make that assessment as a
20 requalification after fifteen years?

21 MR. TOUGHIRY: Excellent question and the
22 answer, Jack, we are getting closer but we are not

1 there yet.

2 MR. WERT: Thank you, the second question
3 would be do you have an idea or have you set a goal
4 if you will on what that extension period would be?

5 MR. TOUGHIRY: Well we have already set up
6 one precedent for only one application, a very, very
7 unique application but very limited use. The maximum
8 for additional service life was fifteen years with
9 the requirement of being assessed once every five
10 years using the very detailed extended inspection
11 using CG pamphlet C6-2 as well as application of MEO
12 testing during the re-qualification so I did not
13 answer your question comprehensibly because I dabbled
14 only for one application. That is one of our goals,
15 to see if we could do this across the board.

16 MR. WERT: So you have not made that step.

17 MR. TOUGHIRY: That is correct yes.

18 MR. WERT: Thank you very much sir.

19 MR. TOUGHIRY: Sure.

20 MR. PAQUET: All right I'm very proud of
21 Mark, Mark and I have had meetings together, good job
22 Mark.

1 MR. TOUGHIRY: Just follow the direction.
2 Thank you everyone.

3 MR. PAQUET: Thank you, excellent job
4 Mark. All right so our next presentation Ben Moore,
5 he is coming up here right now, Ben Moore the floor
6 is yours.

7 MR. MOORE: Good morning everyone as he
8 said I am Ben Moore, again I am an engineer with the
9 Office of Hazardous Materials, Engineering and
10 Research. I am just going to talk to you about our
11 ongoing research projects and some of our upcoming
12 projects packaging testing.

13 Just to give a little background, back
14 roughly in the early 90's, 1990 I may be a year or
15 two off, we at PHMSA and we harmonize with the UN to
16 move from a specification base packaging system to
17 one that's more performance oriented. This offered
18 industry more greater flexibility and potentially
19 lower costs without any change in safety and
20 potentially improvements as well.

21 The main problem is that since then we
22 haven't had many changes to put in the HMR, it's all

1 very, very similar. There has been some additions, a
2 few things, but a lot of it is just very, not a lot
3 has changed in over twenty-five years and that could
4 be an issue.

5 What this has led to is a number of
6 variations amongst the various testing facilities
7 across the country that includes our third party labs
8 and the self-certifiers who test their own packages
9 to put on the market. So we have a number of ongoing
10 initiatives right now.

11 One regarding the conditioning time of
12 packages prior to the drop test, specifically that's
13 about IBCs. Another one on the corner drop selection
14 for combination packaging. Our test methods and the
15 gases used for that, the afflictions of higher static
16 test fittings and some simultaneous by various tests,
17 it is just a stack, but it's pretty much everything
18 we do.

19 Now as far as the conditioning time goes,
20 IBC have very large packaging and they are holding a
21 lot of material or test contents rather. It could
22 take a while to get all of that onto the necessary

1 temperature of zero degrees Fahrenheit. We are just
2 kind of looking at how long we should be testing for
3 and over-conditioning matter and how long it takes to
4 get there to that temperature.

5 Some of those things revealed that a
6 number of facilities around the country do use to
7 have different times that they use in their in-house
8 methods, again we don't have anything set in stone
9 but by how long things are supposed to be done for
10 and some of our experiments have shown a difference
11 in the time it takes for the IBC to reach, just
12 depending on how it's performed.

13 What we would like to do is determine when
14 a more uniform time frame, for how long this should
15 take and get to a point where everyone is doing the
16 same thing, if possible and you will see on pretty
17 much every slide that I have that we want to
18 establish uniformity across the test lives we want
19 everyone doing the same thing as much as possible and
20 it doesn't necessarily have to be anything that we
21 are aware of or anything that we are doing but we would
22 just like to get the best way for everybody.

1 And here is just a couple composite IBC's
2 I don't think the left one is actually used for
3 Hazmat but you get the idea. Again going on to the
4 corner drop for combinations, there is eight corners
5 on a box, every box or a box-shaped object. They all
6 have to be tested on the drop on the corner. We
7 found which the weakest corner, would be the best way
8 of putting it would be and obviously that is going to
9 vary from package to package but we could get to a
10 point where we do know, we have an idea of what the
11 best corner to test on, again for uniformity across
12 the industry and that's just a drop tester, nothing
13 too exciting. That's not a dropping of the corner,
14 obviously.

15 As far as the leak proof-ness tests go, we
16 offer a number of ways to test, we offer, we want to
17 see if there is any better test methods or alternate
18 test methods versus what the HMR specifically
19 authorizes and we do just have a very general
20 statement that is suitable gasses may be used other
21 than air and be kind of like to fair what those
22 suitable gasses are, maybe some work better than

1 others or are easier detectable or any cheaper to
2 use, I don't know how that would be but we can look
3 into that.

4 And we want to evaluate compressed air
5 specifically as one of those. We do know that there
6 are some other methods available and some are being
7 employed by approvals, we want to look into those as
8 well and see how they compare, if they are better or
9 worse. It should be made to put in the HMR, more
10 specifically and again just for uniformity across the
11 industry.

12 As far as the hydrostatic testing goes we
13 don't again specify where to put your fittings, when
14 you are doing a hydrostatic pressure test that allows
15 labs basically they can put it anywhere and we would
16 like to see if there is any gusts position or really
17 it doesn't affect the test. Our preliminary research
18 so far as shown that it really doesn't make a
19 difference, you pretty much get the same results no
20 matter where you put those fittings in the package.

21 Do you think we should continue to look at
22 that and again get to where we develop a guide on

1 where to put those fittings?

2 And the last one we have is for
3 simultaneous testing of packages. Currently we don't
4 have it, we have to test one package at a time and
5 that leads to a situation in many labs where they are
6 testing multiple packages at a time and that applies
7 to a stack vibration, hydrostatic and leak proofness
8 tests. We just want to see if that has any effects
9 on the results of the testing versus the testing of
10 an individual package at one given time and if it's
11 adequate to test all three at once.

12 And again we just want to get some more
13 uniformity, if it works out then. Just some packages
14 being tested all at once, I guess that looks like a
15 recruitment site. For some of the future stuff we
16 are looking at, again we have route cause research,
17 so we are looking into the reuse, reconditioning
18 manufacturing of packages and then further some more
19 leak proofness testing, specifically regarding IBC's.

20 As far as the root cause of our research
21 goes, we just want to see if we can do any analytical
22 research of our packaging data for root causes of the

1 failures, to determine any bid elements to identify
2 the root cause of the failures and create a method to
3 identify gaps and vulnerabilities within our
4 regulations and then we will provide recommendations
5 based on that.

6 Next one thanks. For the
7 re-manufacturing, or re-conditioning, reuse or
8 re-manufacturing we just wanted to determine if in
9 addition to leak proofness testing, there is any
10 other testing that would be good to use when re-using
11 re-manufacturing or reconditioning packages,
12 currently that is as far as re-use and
13 re-manufacturing and reconditioning goes that's all
14 that is required for a package and we are, we would
15 like to see if that is adequate, or perhaps we should
16 look more into that to determine if there is more
17 that should be done to those packages before they are
18 reused and put back on the street.

19 And then the final one for IBCs we have,
20 we want to look at the leak proofness testing because
21 we are very vague in some aspects of this test, we
22 don't even say how long the test should be performed

1 for simply stating a suitable length of time and that
2 has led to a situation where we don't really know
3 what a suitable length of time is to determine
4 failure and we just wanted to take a look at that as
5 well as the various methods of detecting leaks
6 throughout the test and see if there is a good way of
7 doing that and again provide some recommendations and
8 perhaps make some changes to regulations to better
9 reflect that research and that's what I've got.

10 MR. PAQUET: I suspect there is going to
11 be some questions and we have twelve minutes for
12 questions right now.

13 MR. PETTIT: All right, CL Pettit with
14 Reusable Industrial Packaging Association, that next
15 to the last line really through me, can you elaborate
16 a little more of what other tests you might be
17 looking at or candidates to applied reconditioning
18 beyond the leak proofness test and where will that be
19 done is that all in and what will be the roll out,
20 can we as re-conditioners be.

21 MR. MOORE: Right I figured you would have
22 some questions about that one. Right now we are

1 just, like I said we are in the preliminary, we
2 haven't even started this at all beyond that. Any
3 further, what further tests will have to be
4 determined, I don't have any specifics, obviously
5 more destructive testing is not going to be very good
6 for something you are trying to use again so, but we
7 are looking into that.

8 Can the industry be involved? I don't
9 know we will see why would that, I don't know how
10 that works. He asked if we can have the industry
11 involved with some of this research, more directly
12 involved than this and I don't have a good answer.

13 MR. PETTIT: One real quick, I know that
14 time is limited. I would say that shouldn't this
15 come at the UN level perhaps so that when you are
16 delving into a possible, the additional production
17 test for reuse of re-conditional, might that not be
18 better to plop at the UN first or at least be made as
19 a UN paper, I don't know.

20 MR. MOORE: I mean that's got to come from
21 somewhere, that's all I can really say.

22 MR. PETTIT: All right, we'll talk.

1 MR. MOORE: Okay.

2 MR. PAQUET: Yeah.

3 MR. RICHARD: Bob Richard from Labelmaster
4 Services basically that is what I was going to say, I
5 applaud your efforts because I think there is a lot
6 of room for improvement in the UN packaging tests.

7 There is a huge disparity between what's
8 tested by the industry and what the industry finds
9 when they do the test and from one lab to another so
10 the test methods definitely could use some
11 improvement, but as you said I think you could
12 leverage the resources and prove the outcome of this
13 research by taking a simple information paper to the
14 UN and saying we are going to be conducting research,
15 we are going to be doing these tests, they may, you
16 may get some very good comments saying no don't do
17 that test because they have already done it and this
18 is what we found out or they might suggest other
19 tests, other things to look out and then they will be
20 willing to enter into working with you to do some of
21 these tests because especially there are a lot of
22 test labs, that are part of government agencies and

1 they are very active in doing this. They even have
2 an ongoing where they can prove that they do that, so
3 that was my point.

4 And then one thing is really my own pet
5 peeve, I just got burned by this by one of my clients
6 is what is the importance of having a specific 8.5
7 point box. I remember twenty years ago standing in
8 the hallway arguing with Don Berger and Ed Misule
9 about tape on boxes and maybe we should do some
10 research and see really how does tape, the type of
11 tape contribute that much to a boxes ability to pass
12 the UN performance test.

13 I just had a box tested at a famous third
14 party lab. I used the standard two inch tape because
15 I knew that it was very common, I could easily get it
16 into place and lo and behold I talked to my client
17 and no we use a three inch tape and he needs a
18 slightly different ASTN standard. So now I just
19 spend multi, several thousand dollars doing a test
20 and they can't use the tape, that's a three inch,
21 that's probably a higher superiority because it tests
22 that way. I mean you really have to think about

1 those things and how it affects us.

2 MR. PAQUET: And as crazy as it sounds,
3 the discussion about tape will throw us outside of
4 our twenty minute discussion period so I have to
5 defer that comment please we need to have that
6 conversation but Hazmat people can talk about tape
7 for a long time.

8 MR. MOORE: We love tape.

9 MS. NAUMAN: Thank you Sue Nauman,
10 Industrial Packaging Alliance of North America and I
11 am well aware of the tape question, it would be a
12 great project. I just have a question for you I know
13 that the third-party labs are working through D10 to
14 you know, settle a lot of these procedures.

15 MR. MOORE: Yes.

16 MS. NAUMAN: Are you involving them at all,
17 I think this is a great opportunity to collaborate
18 with you for self-certifiers and third party labs, so
19 I would just recommend that.

20 DR. EL-SIBAIE: One of my tweaks, if I
21 could provide tweaks is I either want to have the
22 package testing research or so I am sympathetic to

1 all of these comments. I do agree with the need to
2 continue to be more active participants at the
3 meetings and I would even go one step further than
4 taking a paper to the UN, even before we take a paper
5 to the UN or any other international body, it may be
6 even helpful to float the idea, I mean we probably
7 should be having a discussion of whether this test is
8 too vague or this test doesn't give us the right
9 answer that we all want to have or for an agency that
10 is conducive to good decision making.

11 So we should be even that at the onset be
12 conducting some initial testing and conducting some
13 research here to provide options and to provide
14 further guidance. It doesn't hurt us and certainly
15 and I have seen it in many cases with them floating
16 the idea, that this is what is going on with our
17 thinking, we really think this test is not giving us
18 what we need and we need a pen and pencil and let's
19 get feedback, maybe there is a reason, maybe a method
20 or reason why a specific test is not used, so I think
21 and I agree 100 percent that we want to have more
22 collaborative process on package testing and the

1 testing requirements and the process in which the
2 test are being done.

3 MR. PAQUET: Yes, but let me come back to
4 you, I have to sit out there.

5 MR. BARRETT: Thank you Ryan, Ben Barrett,
6 this time acting in the capacity as Vice Chairman of
7 the Dangerous Goods Advisory Council. Thank you Ben
8 for this project we appreciate it and I will keep my
9 comments short. DGAC is representing a significant
10 number of packaging labs and I think that it has been
11 their experience that this is a very important
12 ongoing subject right now, of great interest so I
13 will keep my comments short but it is very important.

14 And I think, I also will make a fifteen
15 second comment on tape. I think this is symptomatic
16 of a prescription inside the test report saying you
17 know a certain component was used and this is very
18 detrimental and we should really take a look at that
19 with research that would establish to what level of
20 prescription is really necessary.

21 We have been concerned with, while we very
22 much appreciate and respect lots we are also

1 concerned with their testing failing of very high
2 percentage of packaging successfully tested by our
3 third party professional packaging labs so we would
4 like to see, make sure that the research is done,
5 that the test metrics are definitely verified as
6 being in alignment with legal industry practices and
7 again we would also support involved of the UN.

8 Thank you.

9 MR. TOUGHIRY: With pleasure, just a piece
10 of the information that is relevant to the retesting,
11 we have alternative testing that is used for
12 different kinds of packaging such as alternatives and
13 something automation and as far as the timing for the
14 whole time we have a number of standards which
15 provides direction with how we manage to hold the
16 pressure to find out if it is equal or not.

17 MS. NAUMAN: Yes, thank you I just want to
18 recognize, it's Susan Nauman Industrial Packaging
19 Alliance, and I think it is really critical that you
20 are focusing on the verifiability and for that reason
21 it is really good to have collaboration. I have a
22 background and there is a lot of value in having a

1 test and an operator do that test and then having
2 different operators in other labs, that's how you
3 really get your range on your testing specifications.

4 MR. PAQUET: Great, excellent, thank you
5 Ben.

6 MR. MOORE: Thank you.

7 MR. PAQUET: All right, our next
8 presentation is near and dear to my heart, the
9 paperless hazard communication pilot program and I
10 will introduce Mark Raney.

11 MR. RANEY: Good morning hopefully
12 everybody can hear me okay and can understand my
13 Boston accent. I'm sure Ryan will keep me honest in
14 the volume I can't help you with the accent. So I am
15 going to be going over and providing a brief summary
16 on the ongoing Paperless Hazard Communication Pilot
17 Program, otherwise known as HM access.

18 I will be providing a brief background,
19 all of you in the background, I'm sure many in this
20 room are already familiar with it as well as what the
21 intent of the program is, followed by a summary of
22 some of the major accomplishments that we have

1 completed to date and then what the next steps and
2 expected outcomes of the project are.

3 So the HM access which stands for
4 hazardous materials automated cargo communications
5 for safe shipments, otherwise known as Paperless
6 Hazard Communications Pilot Program which is all a
7 mouthful so I am going to refer to it as HM access
8 during this presentation was first conceived in 2008
9 and then in 2009 PHMSA held a public meeting to get
10 feedback on the purpose and objective of the
11 initiative and then in 2011, Spring of 2011 an
12 interagency agreement was established between PHMSA
13 and the Volpe National Transportation System Center.

14 And if you are not familiar with the Volpe
15 Center, part of the department we are under, we are a
16 part of the US DOT under the Research and Innovative
17 Technology Administration. Now the requirements for
18 the project are defined within Map 21 under Section
19 33005 the Paperless Hazard Communications Pilot
20 Program.

21 The goal of the program is to evaluate the
22 feasibility and effectiveness of paperless hazard

1 communication systems in regards to providing the
2 equivalent or better level of safety to the current
3 paper base requirements.

4 The evaluation needs to account for the
5 potential impacts as well as the concerns of a
6 variety of stake holders within the hazardous
7 materials community including federal agencies, state
8 authorities, and significantly in terms and regards
9 to law enforcement response community as well as the
10 hazmat industry, meaning shippers and carriers.

11 The intent of the project is to study the
12 performance, safety, security impacts and associated
13 benefits and costs for using these systems for
14 communicating the paperless shipping, excuse me, the
15 hazardous material shipping paper information as
16 currently required by regulation and it needs to look
17 at under all modes.

18 There are really three major requirements
19 under map 21. There are three phases the first phase
20 is consultation with hazardous material stake
21 holders. The second phase involves testing the
22 performance of these systems and evaluating the

1 potential impacts associated with implementation of
2 those systems and thirdly a report needs to be
3 prepared on the results and recommendations for the
4 secretary to provide to Congress.

5 The initial consultation phase of the
6 project has been completed. Per map 21 we have
7 consulted with HM stake holders on the operational
8 and technological requirements for implementing these
9 systems across all modes. The purpose of these
10 meetings was to obtain information requirements as
11 well as benefit from experiences from others that are
12 already implementing similar efforts, such as EPA
13 with their e manifest system.

14 We met with ninety plus individual
15 hazardous material stake holders representing all
16 modes, other agencies, associations of different
17 capabilities and of different sizes for all stake
18 holder groups, there are responders, law enforcement,
19 shippers and carriers.

20 Following these meetings, there was a two
21 day workshop held at headquarters here in September
22 2012, I know many of the folks in this room were at

1 that workshop, we thank you for your attendance at
2 that and the purpose of that workshop was to verify
3 the needs and obstacles of implementing the system.
4 So we met with all of those individuals but then
5 during that workshop we discussed the results of our
6 findings form those meetings and we wanted to get
7 additional feedback to make sure what we heard is
8 representative of others that weren't able to meet
9 with us at that time.

10 The information from those workshops and
11 those meetings were then summarized within two
12 information papers, now those information papers kind
13 of highlight the collective hazardous materials
14 communications priorities, gaps and concerns that are
15 related to implementing these systems as they relate
16 to us.

17 One paper was focused on the concerns
18 associated with responders in law enforcement and the
19 other was more focused on industry in terms of
20 shippers and carriers, both of those papers are
21 available on the hazardous materials, the HM access
22 public website.

1 So we completed that first phase in terms
2 of the consultation with stake holders. We are
3 currently in the second phase in preparing for a
4 testing and performance and collecting information on
5 potential impacts.

6 Last April many of you may have seen,
7 PHMSA posted a website update on plans for a pilot
8 test and then that was followed in July with a sixty
9 day notice. That notice, basically notifying stake
10 holders and the public of the planned pilot test and
11 seeking volunteers to participate with the pilot test
12 and also for a comment and feedback on the data
13 collection that was identified in that notice.

14 In regards to both the website
15 announcement and the sixty day notice, we have
16 actually received eight-three comments, a majority of
17 which were volunteers to participate in the pilot
18 program. Seventy-three of those eighty-three were
19 actually volunteering to participate in the program,
20 representing all stake holder groups we got a good
21 representation across different communities, both
22 from industry as well as emergency law enforcement

1 side.

2 Ten of the comments were more focused on
3 comments in general to using e systems, many of which
4 echoed what is identified in the informational papers
5 and some of which were more focused in terms of
6 future regulatory concerns or changes, which is a
7 little bit outside of what was within the notice.

8 On November 25th, so right before
9 Thanksgiving, a thirty day notice was published.
10 That thirty day notice addressed responses to the
11 comments that was from the sixty day notice as well
12 as providing the specific questions that are going to
13 be asked as part of the data collection activity that
14 is identified within the sixty day notice.

15 In the sixty-day notice we identified the
16 type of information we are going to ask and try to
17 collect during the pilot test and during the data
18 gathering to support the potential impact analysis,
19 but and then in the thirty day we actually included
20 all of the specific questions that are going to be
21 included.

22 So where are we now the PRA packet, that

1 thirty day notice that was published on November
2 25th, the comment period has closed, that closed on
3 December 26th and the PRA package is currently with
4 OMB for review. So once we receive OMB's approval on
5 the data collection activities, the next step will be
6 to select participants for the pilot test, those will
7 be selected from the pool of volunteers we have
8 received and we will be looking at those volunteers
9 to one make sure they satisfy the requirements for
10 participation as identified within the public notices
11 as well as looking at their capabilities in regards
12 to which are best suited to be able to aide in the
13 testing of the performance systems per map 21
14 requirements.

15 Once we have identified the participants
16 themselves for the pilot test, we will then hold an
17 orientation meeting and actually conduct the pilot
18 test. Those tests are going to be conducted with
19 multiple regions across the US involving all stake
20 holder groups. The tests will one, at least one
21 needs to be conducted within a remote area, per map
22 21 requirements and they will likely occur over a two

1 month period.

2 Concurrent with the pilot test we are also
3 going to be implementing a collection activity to
4 collect information associated with evaluating
5 potential impacts. Now the pilot tests themselves,
6 those are going to be selected participants from the
7 pool of volunteers. Anybody will be able to
8 participate as part of the collection activity for
9 the impact analysis, that will be open to all, not
10 limited to just pilot test participants.

11 Once we have completed the pilot test, and
12 completed that data collection activity for impacts,
13 a report will be prepared and that report will be per
14 map 21 will summarize the pilot test findings, it
15 will assess the safety and security impacts,
16 including associated benefits and costs for using
17 these systems and then provide a recommendation on
18 whether the regulation should be changed to allow for
19 the option of using the e systems in the future.

20 It is a large scale project, a very brief
21 summary, there has been a lot of activity but I will
22 open it up to questions and answers at this time.

1 MR. RICHARD: I am not in a competition
2 Bob Richard, Labelmaster Services. I have been
3 working with a number of stake holders and my company
4 is very interested in this and it can seriously
5 promote safety. Right now even though a vehicle that
6 starts off at a manufacturer's facility and has ten
7 stops on the way and you never have to activate the
8 shipping papers, so you can be on your last leg, you
9 have one drum left on the truck and if there is an
10 incident and the firefighters look at the shipping
11 paper, they are thinking it's a vehicle full of
12 something so that's just ridiculous.

13 Electronic communications, you can tell
14 them exactly what is on that vehicle and give them
15 time, it is going to cut down on congestion and it is
16 going to make it safer and it is just so much better,
17 so it is almost a no brainer but we have to go
18 through the congressional mandate.

19 My one question is with regard to the
20 number of the selection of the applicants and a
21 number of pilots, in my mind it would make sense to
22 have as many pilots as possible, you have done a good

1 job to identify the criteria and how are you going to
2 measure this, this will be good for your report, but
3 it seems like to me that it might be more limited. I
4 would think you would want all of the options of the
5 pilots as long as they follow all the rules and you
6 get the data why not have as many pilots as you
7 possibly can and that's where from your presentation
8 I am still a little bit, I don't understand totally.

9 How many pilots do you perceive that you
10 will do, are you trying to limit the number or are
11 you open to doing as many as possible?

12 MR. RANEY: We are not looking to limit
13 the number but they do need, it needs to be focused
14 on use with shippers and carriers. We are not
15 looking to test vendors and consultants, so that is
16 one aspect.

17 Just one more thing, the tests themselves,
18 we are going to be conducting inspection simulations
19 and emergency response simulations so to participate
20 in those simulations, the participants have to be
21 actually moving hazardous material shipments and the
22 other piece that is kind of a limiting factor in

1 terms of the numbers and where they can occur, there
2 is two enemies involved.

3 We have the shippers and the carriers on
4 one side on industry as well as the emergency
5 response and law enforcement and we are going to be
6 relying on the emergency responders and the law
7 enforcement to be conducting the simulations and
8 providing the information so the locations for, in
9 terms of where those participants are will also in
10 some respects, limit the pilot test that can occur
11 and who can be involved with those pilot tests, so
12 they have to be participating within those areas.

13 MR. RICHARD: So when I read the notice I
14 saw something about excluding vendors, software for
15 instance, my company sells software. What we are
16 doing is we are pulling together a group of people,
17 including shippers and carriers, emergency
18 responders, emergency response information providers,
19 law enforcement and saying we are all going to work
20 together to do a pilot, so if my company is
21 characterized as a vendor, I think that is very
22 unfair because we are bringing shippers, carriers and

1 emergency responders and prospectors to the table so
2 we want to be characterized as a group of people with
3 an interest in pilots and just because one of those
4 participants, the one with the most effort, happens
5 to be one with software, they should not be excluded,
6 but it's on the record.

7 MR. RANEY: We have been.

8 MR. STEVENSON: Boyd Stevenson, American
9 and Chinese Associations. EPA is simultaneously
10 working on electronic hazardous waste manifest and
11 recently indicated that it may be coming to fruition
12 very soon. I wanted to know if you were looking at
13 that possibility of incorporating that such that we
14 would have no haz waste, no physical haz waste
15 manifest and an electronic hazmat shipping paper at
16 the same time. Have you looked at that at all?

17 MR. RANEY: We have been in close
18 communication with EPA in regards to the manifest
19 system. One different to keep in mind is that an EPA
20 they are actually establishing and going to be
21 administering an electronic system that is going to
22 be utilized. What we are looking at isn't actually

1 creating a system, which is what we are looking at
2 and a lot of this is based on the feedback that we
3 heard is to more allow for the use of e systems and
4 have it be more performance based requirement.

5 So not saying you have to use this
6 specific technology to communicate it, but more in
7 terms of you have to meet these requirements to
8 communicate it and with regards to e manifest for
9 hazardous waste, all of the information that is
10 included on the e manifest, those elements are also
11 going to be required as part of the shipping papers,
12 so once electronic shipping papers are allowed, you
13 know the information that is communicated in support
14 of hazardous waste would cover those requirements as
15 well.

16 MR. PAQUET: All right well thank you
17 Mark. Good job.

18 MR. GOLDSTEIN: If you don't mind, this is
19 down the road, Jim Goldstein with International
20 Association of Fire Chiefs. One of the issues that I
21 have worked on besides all of this stuff is
22 communications issues, public safety. Listening to

1 this conversation, at some point down the road,
2 somehow we have to get connected in with the first
3 net, you all have heard of first net, it is going to
4 be a broadband network for first responders and all
5 kinds of applications are being put into their
6 contents. Legislation came out of the so called Egon
7 Bill back in February 2012, they are part of
8 commerce, an independent authority, former chairman
9 and I know a lot of the staff over there so at some
10 point if we just listen to this somehow your
11 application, assuming e net is going to go forward
12 and electronic pagers, that ought to be from a first
13 responder community, ought to be integrated into
14 first net.

15 Now we may be talking two, three years
16 down the road but I just don't want to get anybody
17 blindsided, you know from the sugar carrier software
18 vendor or the federal agent of PHMSA that just seems
19 like a natural to me and if you need any help on that
20 or any input, I know a lot of the staff and some of
21 the members and I would be happy to help with that.

22 MR. RANEY: I appreciate that Jim. One

1 other thing just to make sure everybody understands
2 too, during the pilot test, what we are testing is
3 the existing capabilities out there so we are not
4 going to be providing any equipment. We want to be
5 testing how well the communication performs these
6 systems perform, utilizing the existing resources and
7 equipment of law enforcement emergency responders as
8 they have out there right now.

9 MR. PAQUET: Thank you, thank you very
10 much. We are going to take a twelve minute break,
11 twelve minutes, be back here in twelve minutes.

12 BREAK

13 MR. PAQUET: All right, so a couple of
14 administrative things here oh you came in after the
15 door closed. I was just told that one of the fax
16 number on at least one of the papers is incorrect. I
17 see a lot of Ipads and cell phones out there, if you
18 are faxing something, that's partially your fault.
19 Let's not fax something to us, it will show up on one
20 of our fax machines, but you know it's 21st century
21 so let's try to email these things. Yes, thanks how
22 would you staple these things, so when we post all of

1 these presentations, there will be a link.

2 We will create an R&D inbox, it will be
3 email it will be something like PHMSA and R&D, don't
4 write this down, PHMSA R&D.gov just like the
5 approvals at .gov so there will be a link on the
6 website, so click there, that will be a great place
7 for you to send in any comments, email us and we will
8 keep that alive from here on out so it will be a
9 great opportunity for you guys to propose projects
10 and to be in contact with the R&D branch from here on
11 out.

12 And that will be coming, when we post the
13 presentations that will be there, it is not there
14 now, do not search on your Ipad and try to find it
15 because you will not succeed. All right so our next
16 presenter is Brian Vos from our science branch
17 talking about exposure to risk of exposure thank you
18 Brian.

19 MR. VOS: Good morning everyone. You have
20 got me for the next two presentations they are about
21 forty minutes, depending on comments. For this one,
22 the risk of exposure to 1.4S explosives to emergency

1 responders I just wanted to give a very brief
2 disclaimer. The next two talks are based on
3 statements of work that were drawn up by Dr. Spence
4 Watson, formerly of the scientist branch and one of
5 the things we are really looking for in this public
6 forum is to be able to take comments from industry,
7 from others who might be experts in these areas, and
8 maybe fine tune, not stick to the statement or work
9 that was previously drawn up necessarily but really
10 just redefine what we see as a possible problem and
11 move on and see if we can find solutions together.

12 So why study the risk of exposure for
13 emergency responders to 1.4S explosives and the scope
14 here of course we are just looking at 1.4S we have to
15 start somewhere, obviously there could be risk of
16 exposure from the 1.3's, 1.4's et cetera but the
17 criteria for 1.4S specifically was originally linked
18 to risk assessments for explosive responders but the
19 criteria has changed and the emergency response
20 procedures may have changed, I'm not an expert on
21 emergency response procedures but I imagine there are
22 some people here in the room who may have good

1 comments on that.

2 For instance just one very brief example,
3 in the first revision of the manual and test
4 criteria, one of the specifications said that if you
5 have any indentation at all in your witness screen, you
6 could not be in 1.4S. Now you are allowed up to 4
7 millimeter dents in the witness screens and you can
8 still be in 1.4S.

9 The location of the witness screens used
10 to be five meters from a fire, now it is four meters
11 so all that is really just to say that the criteria
12 may have changed over time. We just want to really
13 do a re-base lining, it is critical that we keep our
14 emergency responders safe when they are responding to
15 events that may have 1.4S explosives and so we really
16 just want to do a study, maybe involving a survey to
17 find out is there a gap between the current criteria
18 for 1.4S and the emergency response such that we know
19 that they are adequately protected from many events
20 that may occur.

21 So research is necessary to identify if
22 there is any gaps between those two. Very briefly,

1 getting at the test criteria, I am not getting into
2 the test series 3 and 4 which are more like the
3 thermos ability impact, friction, small scale burning
4 tests, those are really just to determine if your
5 explosive is forbidden for transport or not.

6 When you get to 1.4S classification, you
7 primarily do it through the test series 6 and you
8 have the 6A test which is a single package, as
9 packaged for transport, you initiate it either with
10 its means of initiation or with a detonator or
11 igniter, I'm not trying to get into the specifics,
12 but essentially in the 6A test you are looking for
13 mass detonation or mass explosion and if there is
14 evidence of that you would be in division 1.1
15 potentially unless you are on a 6B test.

16 The 6D test is a more recent test and it
17 is only used at the present for eight UN numbers
18 which reflect certain articles including power
19 cartridge devices, charges for explosives and
20 detonators. The criteria for that is a little more
21 strict, in that essentially it is looking for effects
22 outside of the package and if you have major effects

1 outside of the package then you cannot be 1.4S for
2 those types of devices.

3 The 6C bonfire test which I am going to
4 spend a majority of the time talking about is a, you
5 take packages as packaged for transport. You try to
6 get a volume of .15 meters cubed you put them on a
7 fire that kind of relates to the talk earlier that
8 Joe gave about the propane fire. You are trying to
9 have a fire that is around 800 degrees centigrade and
10 you want to have it overlapping the edges of the
11 package by at least a meter.

12 You are trying to replicate a transport
13 scenario and if you go on to the next page the
14 criteria specifically for 1.4S fireball jet cannot
15 exceed one meter from the packages, fiery projections
16 cannot exceed five meters from the packages. You
17 have witness screens placed on three quadrants from
18 the packages and they cannot be dented more than four
19 millimeters, no projection with kinetic energy
20 greater than 8 jewels and then there is a thermal
21 effect criteria looking at how many kilowatt per
22 meter squared at certain distances so you have a

1 thermal effect also.

2 But what they are really just trying to
3 say is that there is very definite and specific
4 criteria that you can evaluate in the test and then
5 you get into what the emergency response is and you
6 start seeing some more subjective terms from the
7 model regulations, sorry next line, from the model
8 regulations definitions of the 1.4S and I am not
9 going to read it verbatim but essentially you have
10 substances and articles confined within the package
11 unless the package is degraded by fire and that talks
12 about projection and thermal effects limited to the
13 extent that they do not significantly hinder
14 firefighting or other emergency response efforts in
15 the immediate vicinity of the package.

16 And the italics in there are all mine,
17 they are not in the book. But there is some
18 subjectivity in that, in the first revision of the
19 manual and test criteria, it used to say immediate
20 vicinity and then in parenthesis it says for instance
21 five meters. That is no longer in the book, I think
22 a lot of people probably still just historically go

1 by that guidance but it is not prescriptive.

2 The Emergency Response Guide, you have
3 some of the similar language effects usually confined
4 to the immediate vicinity of the packages and then if
5 fire threatens the 1.4S packages, consider isolating
6 at least 15 meters in all directions. Now that is
7 for the general public, but as far as firefighters or
8 emergency response themselves, it says they can fight
9 the fire from a reasonable distance and once again we
10 just want to see if there is a gap between the test
11 criteria that we have used to assign 1.4S next slide
12 and what the emergency response currently is.

13 Now these bullets, this is my last slide,
14 these come from the original statement of work, we
15 don't intend to try to limit, like this is the
16 direction we would go with the research, we really
17 want to solicit comments from interested parties and
18 you guys on what we could do.

19 But for instance, it would probably
20 include a survey of interested parties to see well
21 what is the typical gear for a responder or
22 firefighter, what are the typical procedures that

1 they might approach if they are trying to fight a
2 fire that they know has 1.4S explosives in it.

3 We could try to do a survey or a
4 comparison between different test methods or physical
5 risk responders for fire and fragment and survey and
6 see which one maybe is the best way to initiate the
7 firefighters emergency response to the criteria and
8 in the end we could have field trials with typical
9 1.4S articles, there are not so many typical 1.4S
10 substances because usually it is the packaging that
11 gets the substance to 1.4S whereas you have articles
12 that might inherently fall in the 1.4S category so
13 it's pretty wide open at this point, it really just
14 comes down to when we debated the UN level doing
15 harmonization, we debate around these criteria and we
16 just want to make sure that we haven't strayed too
17 far from what the emergency response was or the risk
18 for the emergency response that this criteria were
19 originally closely associated with, so that's it for
20 the presentation.

21 MR. PAQUET: Yes, we have some action.

22 DR. COVINO: Josephine Covino, Department

1 of Defense Explosive Safety Board that was a nice
2 presentation. I am just going to suggest that the
3 Department of Defense has spent a lot of money
4 because upon ships we do have to fight fires and the
5 thing is that one of the discriminators that is used
6 which you don't have as a test criteria is time
7 dependence of reactions, time dependence is very
8 important because you know a fire fighter needs to
9 know is 1.4S going to stay 1.4S if it is subject to a
10 fire for a half hour, or a fire for two hours, a
11 degradation of the material so are you considering
12 putting that kind of stuff in there?

13 MR. VOS: We are open to pretty much
14 anything. We are really hoping to get a lot of
15 comment on that, so yes.

16 MR. PAQUET: And remember this is a
17 proposed project, so this is where you guys, your
18 comments both today and follow up comments will help
19 us to find what direction we go so this is where we
20 need, well right now we need brief comments, but all
21 of your comments will be provided to us.

22 MS. HILTON: Cynthia Hilton, Institute of

1 Makers of Explosives so we were, I really Brian I
2 really do appreciate your presentation, so you could
3 imagine that when we first saw it we kind of went huh
4 and then, you know because we went back and looked a
5 little more, and we didn't see any of that emergency
6 responders in there at all and so for a risk base so
7 but what I understand is this going back to my
8 members, I would say that this UN that you are
9 relooking at a test, reaffirming tests and what you
10 are really trying to, it sounds to me, so tell me if
11 I got this wrong, that you are saying that the ER
12 guidance now may not be, it might be too conservative
13 based on how we are packaging and how we are managing
14 this project now, is that correct?

15 MR. VOS: I think at this point I would
16 not be making any statement as to which needs to be
17 changed or even if there is a gap it is not like I am
18 coming and saying well the ERG is clearly wrong, it
19 needs to be more specific. One of the things that
20 hopefully we can find out with a survey for emergency
21 response is well how would you typically, what would
22 you interpret as significantly hindering or

1 approachable distances and things like that.

2 Really it just comes down to we want to
3 make sure that emergency response is safe. There may
4 not be incidents in the path where firefighters have
5 been injured fighting fire, yeah that would get at
6 the risk but that doesn't mean you need to set your
7 criteria and the hazard a large distance apart. You
8 want to make sure that when a firefighter is
9 approaching that they are protected with a
10 significant safety factor, just seeing how close they
11 are really at this point.

12 MS. HILTON: Okay but the deliverable out
13 of this is like, it's towards the new ERG would say
14 is that where this is going?

15 MR. PAQUET: We don't know that's part of
16 the problem, we are just trying to see, so that could
17 be certainly.

18 MR. VOS: I wouldn't want to answer the
19 question by saying our goal is to change the ERG and
20 we are looking for data to support that, because that
21 would be incorrect.

22 MR. BARRETT: Hello Ben Barrett, Sporting

1 Arms and Ammunitions Manufacturers Institute. I am,
2 my comments are not going to be particularly brief, I
3 believe this research project is a response to
4 something that our organization spearheaded and I
5 want to say that originally we felt that this
6 proposal is misguided at best but Brian we are very
7 encouraged to see that you are involved with this and
8 also that PHMSA is taking a new look at this and I
9 say that factually we are going to be generally
10 supportive.

11 I wanted to establish our credentials, CNB
12 has partnered with two fire training videos with the
13 International Association of Fire Chiefs so we are
14 very concerned, and very active in the protection of
15 fire fighters. There is a gap between the 1.4S
16 criteria and response procedures, not only if it
17 weren't for us, but it weren't for other than us and
18 that gap in our opinion is that the regulations are
19 overly prescriptive.

20 The criteria that one must pass to achieve
21 a 1.4S rating of an explosive is something that
22 flammable liquids and aerosols many times will fail

1 so many hazardous materials will not pass this test
2 as far as a 1.4S rating and everyone needs to
3 understand that and then once we do achieve the 1.4S
4 rating, we are treated more strictly than these other
5 products that won't pass it and that is very
6 important.

7 With regard to what originally stimulated
8 this, you have to pass five different criteria and as
9 our colleague mentioned the time within the rate of
10 heat output is one of those criteria. There are five
11 stringent criteria and you have to pass them all.
12 What are our recent change was is that beyond passing
13 all five technical criteria, some of the rating were
14 certainly subjective the additional six requirements,
15 that if there was someone in plain clothes that might
16 be in the immediate vicinity, you would say he passed
17 all of the criteria but you are still not 1.4S
18 because subjectively we think it might hurt a
19 paramedic.

20 The fact is that paramedics and policemen,
21 fire fighters would have more protection, but people
22 without personal protective equipment cannot stand

1 five yards, five meters from a dangerous fire, I'm
2 sorry, they have no business standing next to a
3 burning truck, you know tire fires, et cetera.

4 So that's our reservations, but Brian, I
5 believe that you are going to do some good work here.
6 We have been studying we are doing research of our
7 own. We want to study to see the energy requirements
8 of projectiles as they relate to fire fighter turnout
9 gear that is something we would be willing to partner
10 on.

11 Another thing is that we have seen screens
12 from this bonfire test that you are going to talk
13 about next, there are problems with the metrics on
14 those and that is very technical and needs to be
15 improved, so that's our comments, thank you.

16 MR. PAQUET: Thank you and this is again,
17 providing comments afterwards really will help to
18 shape this and all of the other proposed projects, so
19 thank you very much. All right Brian you are still
20 there so you are good to go.

21 MR. VOS: All right, so the next step,
22 this is still new research that is being proposed.

1 Feasibility of improving the UN test series 6C
2 bonfire test, you can go to the next slide.

3 The title sounds very broad like we are
4 looking at everything related to the 6C. I am
5 scaling it back a little bit and specifically looking
6 at bullet two. Current procedures prevent
7 difficulties in measuring the thermal output of
8 energy and energetic events, specifically looking at
9 the thermal flux. So we are proposing research to
10 identify if perhaps new technology or procedures can
11 help quantify the thermal events in the current test
12 set up.

13 I will walk through what the thermal
14 events are or the thermal flux that is necessary for
15 different divisions and then come back to you if
16 there is new technology that can help us measure it.
17 Luckily I don't have to repeat myself too much on
18 this because the previous presentation already talked
19 a little bit about the set up for the 6C bonfire test
20 and Joe already talked about it also with the propane
21 burner.

22 So you have your witness screens four

1 meters from the package edge, next slide. This is
2 just in a nutshell the division 1.1, 1.2, 1.3, 1.4
3 and division 1.4S criteria and I am just highlighting
4 the thermal effect criteria. Now of course, thermal
5 effect is also a little bit reflected in the fireball
6 being greater than four meters and the fiery
7 projection greater than fifteen meters but there is
8 an additional criteria that talks about essentially
9 the heat output in terms of kilowatts per meter
10 squared at various distance from the fire and that
11 specifically is what we are looking at with this
12 proposed research.

13 If you just go to the next slide. This
14 just breaks down the thermal effect for 1.3, 1.4 and
15 1.4S. So it's based on the average thermal flux at
16 various distances, there is also, because of
17 difficulties in directly measuring the thermal flux
18 with the radiometers, you have a lot of background
19 noise perhaps, especially in a wood fire and then
20 it's hard to do a correction for that.

21 There is a shortcut given in the manual
22 testing criteria where you can look at the burn time

1 and the known mass of explosives and that you have to
2 essentially, the easiest way to say it is if you want
3 to have a lower class of classification the burn
4 needs to take place over a longer amount of time.

5 If it burns too rapidly and you get all of
6 that heat and energy output at once you are going to
7 get a higher classification so the difficulty though
8 with doing the calculation is that there is a note in
9 the manual testing criteria that says essentially in
10 some trials you will have separate identifiable
11 events in which case you can use the burn of that
12 identifiable event.

13 What that really comes down to is if you
14 run a bonfire test and you have two drums on there
15 and you see drum one go and drum two go and you can
16 measure the time, you can use the calculation because
17 you know the exact mass in those drums. When you
18 start getting into situations where you might have
19 fourteen packages on a fire, each of which might have
20 ten individual inner packages, you might see separate
21 events but not know whether that was four inner
22 packages that went, or was it three, if you don't

1 know the mass, you can't use the calculation.

2 What we have seen in practice is therefore
3 a lot of labs look at it and says well the note
4 doesn't apply, you can't use the calculation because
5 if you don't see the separate identifiable events
6 essentially the calculation is worthless, so what it
7 really comes down to on this project is saying that
8 thermal effect is something that has been agreed
9 upon, it is in the book, it is something that we
10 measure but in practice trying to get the measurement
11 and quantify 1.3 vs. 1.4 vs. 1.4S a lot of labs might
12 just throw up their hands and say well we can't
13 measure it but don't worry all of the other criteria
14 are met, so I think we can agree upon the fact that
15 we do want to know what that thermal flux is and that
16 it is not exceeded we have to come up with a way to
17 reproducibly record it and measure it, especially
18 when you start looking at just not making sure we are
19 consistent across six explosive test labs that we
20 have in the states, but then you start looking
21 internationally what other test labs do also.

22 Next slide, this is actually the last one.

1 So direct measurement with radiometers may be
2 difficult due to issues of calibration, baseline
3 corrections, especially wood fires, perhaps there is
4 new technology that can overcome this, burn time
5 calculation only works if the mass of materials is
6 known.

7 We have had some people suggest well if
8 you used higher speed cameras perhaps you can get to
9 a point where you could see each individual event,
10 even if you had fourteen packages for instance, and
11 you could see well ok, there is the two second time
12 for one of those inner packages, that's one pound of
13 material, now I can use the calculation and determine
14 if the thermal flux is exceeded or not.

15 The last point, propane fire may burn more
16 evenly with less background noise. This is really
17 carry-over from the propane test that Joe was talking
18 about earlier where if you have a much flatter
19 baseline for a thermal flux, it might be possible to
20 use your radiometers at certain distances and
21 actually more accurately measure the thermal flux
22 that is related just to the energetic event and be

1 able to quantify that so once again just like I said
2 on the previous project, we are not stuck on any one
3 solution, we are really just looking at it as is
4 there a way to reproducibly measure the thermal flux
5 that we can use.

6 The orange book, the manual testing
7 criteria tries not to be prescriptive in how we set
8 up the tests too much but we want to make sure that
9 we are able to reliably and reproducibly calculate
10 the thermal flux so.

11 MR. PAQUET: Thank you Brian, I should
12 have went back.

13 MR. BARRETT: Ben Barrett, we are directly
14 affected by this project this is the last time I am
15 going to speak. This original project was had a
16 very broad title of improving a test but only tests
17 smokeless powder system, very specific scenarios, we
18 objected to that. We are optimistic about working
19 with Brian and PHMSA with reconfigured projects so
20 thank you for that.

21 I want to make one other comment to you
22 Ryan is that this is the first time that we have

1 participated in a PHMSA public meeting like this and
2 it is a very impressive format, I just want to say
3 job well done to you and Lucy and your staff.

4 MR. PAQUET: Thank you, but we are not
5 done yet.

6 MS. HILTON: Again Brian, thank you very
7 much. You know we are like, generally supportive of
8 this stuff that you are doing to help out and in the
9 broader UN look at these tests so I guess my only
10 question here is you said that it appeared to be
11 broader and narrowed it down to this thing.

12 We had submitted a letter suggesting a
13 number of things that could be done to enhance the 6C
14 test and I wonder if you could just kind of on that
15 in general, you felt you had to narrow it because the
16 budget isn't there, you had to narrow it because what
17 we are hearing here today is your plan of work for
18 the next twelve months and you really couldn't do
19 more, could you generally comment on the other
20 improvements that would be worthwhile to pursue on a
21 6C.

22 MR. VOS: Sure, really all that it comes

1 down, I'm somewhat familiar with the comments you
2 sent in although it's been a while since I have
3 looked at them. I think really we just looked at the
4 thermal effect and the thermal flux as being perhaps
5 low hanging fruit where when we see reports come in
6 from our test labs, the thermal flux is not perhaps
7 addressed as well as soon of the other criteria, is
8 it very easy for instance, or much easier be careful
9 what I say, to measure the 20 jewel for instance and
10 the 8 jewel and whether they are correct or not,
11 whether it should be set at 20 jewels or 8 jewels at
12 least they can try to get that measurement and come
13 in and say whether it was exceeded or not.

14 When it comes to thermal flux it is a very
15 set criteria in the book but people have had a lot of
16 difficulty in measuring it so we were just looking at
17 somewhere to start. Are we opposed to opening it
18 back up and looking at something that maybe takes
19 into account projection or fireballs and things like
20 that, I don't think so but we would want to make sure
21 that we have the resources to, however broad we get,
22 we have to find, make sure that we have the resources

1 to cover everything so we can either try to do this
2 one, and one type of thing with the thermal flux and
3 do it well or perhaps have resources spread too thin
4 if we look at too many things, but at this point we
5 are still developing the proposal so we are open to
6 further comment, definitely.

7 MR. SMITH: Greg Smith once again,
8 personal investigator on Agent 14 which is a project
9 funded by the Transportation Research Board that is
10 looking at developing some new tests for the testing
11 and I want to say a couple of observations for you,
12 number one, for doing that work I know how difficult
13 it can be to develop these tests.

14 And then, so my compliments on a job well
15 done and the comment that I wanted to share is that
16 when you are developing tests like this, something
17 that we found in the work that we are doing is that
18 it is sometimes useful to keep separate in your mind
19 the idea of simulating an event in the field and
20 measuring a physical property of the substance that
21 you are transporting.

22 In my own personal opinion it is that when

1 you are doing testing, it is better to measure the
2 physical property of the material and I am not
3 saying, this is just my opinion, so for instance when
4 you are classifying flammable liquids and gas as you
5 may look at auto emission temperature or lower rates
6 of flammability, these are physical properties with
7 the substance safety not directly predicted behavior
8 in the field.

9 And I know that predicting behavior in the
10 field is an important part of assessing the risk of
11 transporting materials but when you try and measure
12 properties of material and predict performance at the
13 same time, those two issues creates enormous
14 difficulty so I just want to advocate that whenever
15 you are developing a new test that you consider
16 whether it makes sense to measure some intrinsic
17 property that separately extrapolates field behavior
18 or try to do it all at one time.

19 MR. VOS: Thank you, actually if I can
20 respond too. It seems like three comments have had a
21 very similar theme as far as kind of referring back
22 to the statement of work previously we are not set

1 necessarily on only looking at the 6C bonfire test
2 and the 6A and the 6B but that would probably be the
3 preference because as soon as you start getting into
4 advocating, like the previous statement the work that
5 might have gone into, well we are going to have a
6 separate test, we are going to look at a single
7 package, a separate burn, you start adding
8 significant cost.

9 It would be much preferred if we can work
10 within the current test set up and maybe just have
11 better instrumentation and better data collection,
12 that would be the preference but we don't want to
13 limit ourselves, either way at this point, so thank
14 you.

15 MR. SANTIS: Lon Santis from the ET
16 Research and Hess laboratory and this is very
17 encouraging Brian because one of the things that I
18 think is encountered out there between the labs are
19 differences in how a test is approached and one lab
20 for example may read in the manual that thermal flux
21 measurements are part of the test and go through
22 great lengths to accomplish that whereas another lab

1 may throw up their hands and say well, you know we
2 looked at the video and so you end up with kind of
3 despairing approaches between the labs so this could
4 hopefully provide some consistency on these great
5 ideas.

6 MR. VOS: Thank you.

7 MR. PAQUET: All right, good job. All
8 right now I will introduce Dr. Richard Tarr for our
9 next presentation.

10 DR. TARR: Hello everyone, can you all
11 hear me? Morning still, okay I'm talking, this
12 research project is going to cover two very diverse
13 fields in the area of fireworks. We are going to
14 talk about novelties we are going to talk about
15 chained shells so vast extremes. When I get my first
16 thought, the first area that I am going to talk about
17 are chained shells.

18 Well what we have found is under first you
19 have to understand how fireworks are handled by the
20 department. We have a standard from the APA standard
21 and as long as you comply with this standard we
22 submit your application to us, we review the

1 application process it and issue you an approval.

2 These shells that go up to ten inches in
3 size contain a fair amount of explosive material and
4 under our default system, our class is 1.3
5 explosives. Now there is a series of these shells
6 that are chained together and those basically handle
7 shells of size from two inches up to five inches and
8 what we found is the standard that we follow does not
9 directly address the issue of chained shells.

10 So we are trying to develop a research
11 proposal to look at and I guess to assure ourselves
12 that the risk of these shells in chained and
13 unchained configurations represent the same risk in
14 transportation. So these are just some images of
15 typical pathogens, you can't necessarily see a whole
16 lot of difference between the image of unchained, a
17 box of unchained shells and the box of chained shells
18 but when you ignite a chained shell, those shells go
19 off virtually simultaneous. It is an extremely rapid
20 transition through that chain and we really just want
21 to answer the question, is that rapidness of lighting
22 potentially ten shells simultaneously versus a box, a

1 typical box will contain, of three inch shells, will
2 contain seventy two shells and this random box of
3 seventy-two shells react similarly to a box of chains
4 that will have seven chains, or seventy shells so the
5 research issue, to answer that question, these are
6 the configurations that we should potentially look
7 at.

8 These are the chains that are utilized by
9 the industry today. Three inch shells I think in my
10 opinion are by far the most common shells out there
11 but up to five inch shells also occur. We would
12 certainly think, looking at the two extremes would be
13 a reasonable approach.

14 Whether we need to look at intermittent
15 sizes, probably not necessary but really we are
16 reaching out for proposals to see if people believe
17 that is the best approach to this type of research.
18 What do we want to know, I mean we have been
19 approving chains currently under our system and we
20 are just looking to sort of dot the I and cross the T
21 to assure ourselves that the risk of these chains
22 really represent the same risk of unchained shells

1 and because maybe it's really just dotting the I so
2 we can be absolutely certain.

3 Under the UN default classification
4 system, which we don't use, they are silent on this
5 issue of chained and unchained. Silent on many
6 issues of fireworks classification so it is presumed
7 that chains would be acceptable under that system but
8 unfortunately the APA standard we follow today is
9 also silent on the chain and unchained so we are
10 attempting to address the issue, but this is the
11 basis of this research proposal.

12 I probably should entertain questions
13 specifically, if anyone has any specific questions on
14 the chain issue before we move to the novelty issue.

15 UNIDENTIFIED AUDIENCE MEMBER: Why, why do
16 they do that?

17 DR. TARR: Why do they chain? Well for
18 finales, you set off, you want a lot of shells in the
19 sky at the same time and to you know, it is just a
20 convenience it's all about convenience.

21 MR. MILLER: Richard Miller International
22 Association of Fire Chiefs, having been a fire

1 marshal and doing inspections on the sites and then
2 inspection of transportation of these, are you going
3 to consider any key boxes which have similar sizes
4 and can have the same effect, three inch shells in a
5 ---

6 DR. TARR: I mean we do know that 1.3
7 cakes can shoot off a lot of material, phenomenally
8 fast. It's not been proposed, I mean you can
9 certainly propose it. There is a lot of materials in
10 those cakes that, the issue with the chains of course
11 is we have chains of a flash composition versus
12 chains of normal display shells and we do need to
13 sort of also address that issue, that flash
14 composition chains, do they potentially transition
15 out of 1.3 to a 1.1 classification.

16 MR. MILLER: Good enough.

17 DR. TARR: Ready for novelties, well
18 novelties have been around for a long time. I don't
19 know if you know what the novelties are but they have
20 been around for over twenty years, incorporated into
21 the APA standard, officially I am guessing a little
22 over ten years ago, maybe fifteen years ago but they

1 have always been around.

2 They were handled under some very old
3 approvals that date back to the mid 80's the next
4 slide will show you. Basically five novelties that
5 we recognize today and I will show you what they are.
6 The little party poppers we all know well, we can
7 find everywhere, the snaps, the snakes, um an 20
8 smokes, she's a very small, probably the least common
9 novelty that I see and then sparklers. We have all
10 seen sparklers they are a very small five gram
11 sparklers.

12 These are the five known novelties that we
13 recognize at the Department of Transportation. These
14 novelties get a very unique status. They don't have
15 to be reviewed to us they are not transported as
16 explosives unless they go on an aircraft they
17 basically are shipped as an unregulated commodity.
18 They have to meet packaging restrictions a lot of
19 restrictions, but one of the issues of course is you
20 want to establish criteria for we get petitions for
21 new materials that want to be considered novelties
22 under the new APA standard that is under review.

1 There are other materials that want to be
2 considered novelties but we don't' really have a firm
3 handle on all of the characteristics of a novelty so
4 one of the goals of this project is to really
5 classify or quantify those properties of these
6 novelty materials so that we know how to expand the
7 family for these other potential candidates, so we
8 are really going to try to really quantify the
9 properties of novelties, establish that criteria and
10 hopefully potentially take this idea to the UN.

11 The UN doesn't recognize these novelty
12 items, they consider them all still standard
13 fireworks but we don't believe inherently that they
14 represent an explosive risk, so our expected outcome
15 of course is to have a solid handle on the property
16 of novelties so we can expand the field to other
17 potential items and have this criteria readily
18 available for everyone, any questions?

19 MR. PAQUET: All right, well then we are
20 good. We are going to take lunch right now we are
21 going to go to the next presentation which is also
22 Dr. Tarr, let me pull it up and after that we will go

1 to lunch.

2 DR. TARR: This actually works out well
3 for me, I don't have to sit here and sweat, you know,
4 get it all done.

5 This next project deals with firework
6 waste. I mean there is waste in the explosive
7 industry, all kinds and in the firework industry and
8 waste is a loose term here because it is not
9 necessarily trash. I mean firework waste is
10 generated by many areas you know, manufacturing just
11 being one but a lot of product that is seized,
12 collected, brought in, it's not in compliance, it
13 goes into storage and it can sit in storage for an
14 extended period of time and you know this product has
15 to be dealt with and you know there is a lot of
16 environmental laws but basically we have a lot of
17 explosive material out there under this guise of
18 firework waste that has to be addressed.

19 And we are dealing with basically two
20 levels of waste, consumer fireworks that you know,
21 say seized in a state that doesn't permit fireworks,
22 or you know display fireworks that were

1 non-compliant, they didn't have approvals, and they
2 just end up sitting there. Fireworks that maybe got
3 wet, damaged in transportation and then the other end
4 of waste, fireworks, you know every fourth of July
5 there are thousands of shows and I don't know that
6 there is any show that manages to shoot a hundred
7 percent of their shells and those shells come out of
8 those shows in various conditions with the matches
9 still attached, partially fired, damaged, broken
10 shells.

11 We have this whole array of scenarios we
12 have to deal with in terms of firework waste. It can
13 be cases, pallets and pallets of fireworks that look
14 pristine, new as can be and yet they have to be dealt
15 with and unfortunately we are looking for, to develop
16 a methodology, we have had, we have issued several
17 approvals over the past to industry like Disney and
18 NP who have been very proactive in trying to deal
19 with their waste situation and develop some
20 strategies to deal with the waste, but we want an
21 industrial standard, an industry standard for dealing
22 with firework waste in these various situations that

1 exist.

2 Whether we are dealing with pallet loads
3 and thousands and thousands of pounds to I have a
4 single three inch shell and I need, I don't have
5 appropriate packaging to put it in but I still have
6 to get it transported back to a bunker. So we want
7 to look at you know, evaluate each of these
8 situations, the relative risk they each represent.
9 Of course, I think cost factors in if we make it too
10 complicated or too difficult my fear is that no one
11 is going to do it.

12 I feel today the problem is essentially
13 ignored and but it represents a huge risk and go to
14 the next slide, I have a picture. Yeah, we have
15 millions of pounds and this is a horrible event that
16 happened out in Hawaii where they were, people were
17 trying to deal with pallet loads of waste fireworks
18 and they were trying to soak them into diesel and
19 they ended up going into the bunker doing this work
20 and the incident occurred and five people died in
21 this event and you know the Chemical Safety Board has
22 pointed out that we lack a standard for dealing with

1 either these large quantities or small quantities of
2 firework waste out there in the industry and I want
3 to be, at least for DOT extremely proactive in
4 developing at least a minimum standard that we can
5 all be comfortable with and if we take these
6 fireworks and we do this and we figure out how much
7 time we need to effectively remedy these products
8 safe to be put back into the transport system, so
9 that's our goal. We want to see what's out there and
10 we want to establish a best practice, one that, you
11 know, acknowledge what the various situations are,
12 there may not be one shoe that is going to fit every
13 situation but can we find the solution for the
14 majority of situations that we face out there with
15 this massive amount of waste fireworks, um, they are
16 just sitting in bunkers, being stored, being
17 collected, you know that's what we have to deal with,
18 that's the challenge we are faced with, any
19 questions? Julie

20 MS. HECKMAN: I let you off easily on the
21 novelties and the chained shells but I do have a few
22 comments on this. You know I think, I want to

1 clarify that the waste situation is not necessarily
2 an industry problem. It is a problem with the
3 confiscation that is going on nationwide typically by
4 the local or the state enforcement authorities, say
5 California only very nominal what we call safe and
6 sane fireworks are permitted but for some reason the
7 full line comes in so they confiscate all of these
8 fire rockets and all of these things that are more
9 energetic and are regulated by the CBSC but they are
10 not legal in that jurisdiction so the local fire
11 people they confiscate them and they are the ones
12 that have this problem with how do we get rid of
13 them.

14 Industry, when we have waste, we need to
15 comply with the environmental regulations, you know,
16 if you are going to store it, you have to have a
17 permit for that. If you are going to treat it, you
18 need to have a permit for it and the industry follows
19 those EPA regulations very, very tightly.

20 As a result of the Chemical Safety Board
21 accident investigation I would clarify it was a
22 government contractor that was doing the disposal and

1 had no familiarity with fireworks and so why they got
2 the contract and why they were messing with that
3 product just stuns me and the whole industry was
4 horrified to see that five people died because of
5 that.

6 The National Fire Protection Association
7 technical committee on pyrotechnics has been directed
8 by the Chemical Safety Board to do pretty much what
9 you've outlined. We have to try to put together
10 guidelines on how you know, how to properly dispose
11 of fireworks.

12 The conservatives trying to take a local
13 fire person who is ordered to do the confiscation and
14 educate them on how to assess what that product is,
15 you know it might be legal and good to get back into
16 commerce where they could use the product as it was
17 intended to be verses this confiscation of illegal
18 explosives like M80's and quarter sticks that are
19 incredibly deadly and lethal, maybe you want the bomb
20 squad, somebody who is thoroughly trained to assess
21 that and then tell somebody how to dispose of that
22 product.

1 So I applaud you for your interest, I do
2 think this is going to be one tough nut to crack
3 because of the variety of products out there and each
4 situation. You know you would have to bring an
5 expert in to look at the product, thanks.

6 MR. PAQUET: I just have one question,
7 could we break down the scope? Should we look at the
8 fireworks as 60% of what comes into the United
9 States, or upwards, so at what point to G world could
10 we break that down and study just one of those, I
11 mean we get certainly the approval and permits
12 division when somebody wants to do a number of
13 fireworks or they come down for a special permit or
14 for the x number, a firework that hasn't been
15 approved, or its' components, Disneyland deals with
16 sweeping up all of the stuff that falls out of the
17 air so for us to be able to give them the x number we
18 have to test it and we don't know what it is, so I
19 guess my question to you would be, understanding
20 where we are trying to go is there a part of that
21 world, a part of that scope that we should be
22 focusing on.

1 MS. HECKMAN: The permitting process for
2 industry number that needs to get rid of it and
3 coming up with how do we test all of the varieties to
4 say what would the classification be? I think that
5 can be done.

6 I think trying to come up with disposal
7 methods to put out in general public with product and
8 demand, now I mean, if it was like in Hawaii, those
9 were overloaded 1.4 all they had to do was go shoot a
10 couple of them and then look at them, it would have
11 been better to just shoot that product that to try to
12 tear it apart and soak it in diesel and all of that,
13 we just don't want to have I guess, our industry
14 affiliated with putting down guidance that anybody
15 could look at in dealing with explosives to try to
16 get rid of it.

17 I think this special permit and that type
18 of analysis, yeah, I think that can be done because
19 it is going to be like this confused project every
20 day where members of the industry who are familiar
21 with the products that they need to get rid of, but
22 you know we typically tell them, have them pick it

1 up, you know it is going to cost you an arm and a leg
2 but at least it is going to be handled safely.

3 DR. TARR: Thank you.

4 MR. PAQUET: All right so now lunch time,
5 some instructions for lunch that I need to give you.
6 If you plan on staying in the building we have a
7 really good cafeteria that is in the other building
8 so basically what you have to do is go out to the
9 atrium, take a right, go down the stairs, come up the
10 other side of the stairs, the cafeteria is there.

11 If you want to leave the building we have
12 about three or four years ago, probably, Carl you
13 were here, there were no restaurants, there was a
14 Subway and a Five Guys and that was it but now they
15 have a bunch of restaurants, we have an Italian
16 place, we have a Nando's chicken, we have Pot
17 Belly's, we still have the Subway and Five Guys, if
18 you want to go to one of them you have to leave the
19 building and most of them are either to the left,
20 down by the water or to the right, we also have a
21 whole slew of food trucks that will be parked outside
22 along that road. We will be back here at 1:05, if

1 you are leaving the building we will have somebody
2 posted out there starting about ten of one to start
3 ferrying you back in, any questions just find a
4 PHMSIN and they will give you instructions, thank you
5 guys.

6 LUNCH

7 MR. PAQUET: All right, a couple of
8 administrative things, we have a sign in sheet,
9 please sign the sign in sheets on your tables. We
10 also have some comment forms, I would love to see
11 those as well, they will also be posted on the
12 website with all of the presentations as well as the
13 email address when that is created, so all of that
14 information will be on the R&D website, and you can
15 keep coming back to it, we hope to have all of that
16 information posted within the next week.

17 We are going to start because I promised
18 we would so I like to keep my promises, there are
19 still people sitting down in the back and the next
20 speaker is Dr. Refaat Shafkey from the engineering
21 branch.

22 DR. SHAFKEY: Good afternoon and if you

1 cannot see me, the fault is not with me, it is with
2 the poor design of this podium so that now that I
3 have given you a perspective of how I look at things
4 I will start with my presentation.

5 Okay safety effectiveness of pressure
6 relief devices that is the first one, so I'll lead
7 with safety effectiveness of pressure relief devices.
8 The pressure relief devices can release flammable
9 gasses and if they are surrounded by other cylinders
10 they can have a chain reaction with raising PRD's in
11 other cylinders and then a small fire can end up
12 becoming a big inferno leading to mass casualties or
13 property damage or environmental damage or things
14 that are all too dear to us and should be.

15 On a smaller scale a PRD release can lead
16 to physical injury to personnel and staff standing
17 nearby so you are essentially we want to see if the
18 PRD's actually enhance safety or sometimes undermine
19 it, I guess that's the bottom line, next slide
20 please.

21 Now I know some of the people here are
22 very well versed in pressure relief devices. Dr.

1 Richards tells me that he has his PhD in PRD's so I
2 am having a little chill here but I still have to
3 keep it fairly basic because keep it interesting for
4 everybody else that may not be all that skilled and
5 knowledgeable in PRD's.

6 So essentially a PRD is a pressure or a
7 temperature activated device. The purpose is that
8 should the temperature or the pressure in the
9 cylinder go high enough that the cylinder can have a
10 catastrophic rupture the PRD would actually act and
11 release the pressure before it bursts, so it's kind
12 of a leak before burst type of device.

13 Now why use PRD's right, we don't have to
14 use them, but here's our regulations they require us
15 to use them Section 173.301F which states that a
16 cylinder filled with gas must be equipped with one or
17 more pressure relief devices, size selected as to the
18 type, location and in accordance with CDA S1.7.

19 So we have to use them because our
20 regulations require them on most of the gasses with
21 the exception of the 2.3 toxic inhalation gas, so
22 that's why we use them here in the United States, but

1 in fact this is not universal and that is one of the
2 reasons why we want to study these and see if others
3 have a better chance, if they have a better
4 experience, why not learn from that, next one please.

5 Where exactly are they located, typically
6 on transportable cylinders, the type in fielding,
7 part of the value, as you can see the PRD is under
8 that cap over there and next one please.

9 Different types of PRD's. Typically we
10 have these four types that are shown here, there are
11 more but these are the typical ones. Figure one
12 shows a CD1 rupture disc, essentially what it does is
13 once the pressure in the cylinder develops to the set
14 pressure of the disc it just pops the disc and the
15 contents are emptied out so that the cylinder does
16 not have to reach the burst pressure.

17 The second one is in figure 2, type CD2
18 and CD3, these are fusible plug type devices and the
19 way they work is once the temperature, as the
20 temperature goes up the fusible metal melts and it
21 causes the contents of the cylinder to end. CD2 has
22 a fusible temperature of 165 and I think CD3 has a

1 212 degree fusible temperature. These are typically
2 used in low pressure cylinders.

3 Then we have a combination fusible and
4 this type of device in CD3, CD4, CD5, what we have is
5 a fusible disc and there is a vacuum of rupture disc
6 so both the temperature and the pressure would be
7 needed to activate this device so the temperature
8 would cause the physical melt and the pressure would
9 cause the ruptured disc to pop. If only thing one
10 thing works then the other one wouldn't be effective,
11 so if only the fusible disc melts, there is not
12 enough pressure.

13 And finally we have figure 4 which is a
14 CG7 it is a re-closable type, all of these other ones
15 that I just showed you were you know, once they open
16 the contents are vented out. The CG7 is a
17 re-closable type, spring loaded device. Once the
18 pressure reaches the set type the seat pops up and
19 causes the contents to vent out and if the pressure
20 drops it is supposed to come back and reclose the
21 vent, but that is the one that is typically used in
22 the propane industry.

1 Now we will take a look at some of the
2 accidents. Here is the one propane cylinder fire
3 recently in central Florida and this was a night
4 fire, in the upper part you can see the inferno which
5 was visible for miles and it was actually a propane
6 cylinder storage facility and from what we know is
7 that one of these cylinders the PRD's actually vented
8 and for whatever reason it caught fire and once that
9 happened it was a refilling facility for the storage
10 warehouse and it kind of got other cylinders into the
11 loop and each subsequent venting cylinder ended up
12 being fuel for the fire and eventually there was a
13 big explosion and the other picture you see here is
14 the morning after the result of all that, next slide
15 please.

16 These were the consequences, injuries,
17 fire critical and no fatalities and over two hundred
18 responders had to be called in to contain the fire,
19 53,000 cylinders, the building destroyed, and the
20 fire could be visible seven to ten miles away from
21 the plant.

22 So a lot of property life and property

1 damage and disruption, here is another one. It
2 involved on a second fire in Dallas, Texas. The fire
3 started from the trailer in the upper left corner and
4 these were mobile settling trailers and there is no
5 confirmation of what exactly started the fire but it
6 looks like one of the fusible discs on one of the
7 cylinders popped and that started the fire and that
8 left two other cylinders getting engulfed in the
9 fire, you can see all these little candlesticks here.
10 These are all PRD's, popped PRD's which eventually
11 led to the middle picture there and then the
12 aftermath you can see on the right one.

13 This happened to be close to Interstate 35
14 in Dallas, Texas which is very busy, especially there
15 and these cylinders were actually jettisoned all
16 across the freeway there and they had to close the
17 freeway in all directions. There were three injuries
18 and two serious and the building was completely
19 damaged. They had to inspect several bridges in that
20 area before they could be reopened and also Dallas
21 doesn't have a whole lot of community rail but they
22 had one or two lanes and they had to close one of

1 them, so quite a lot of damage.

2 Here is another one propane fire in Tulsa,
3 Oklahoma, this was a distributable facility and one
4 of these propane tanks vented out from the PRD for
5 whatever reason, it could have been oil filled or a
6 bad PRD, you know these PRD's are fairly cheap
7 devices, they do not always function all that well
8 and I guess maybe somebody was smoking nearby and
9 that started the fire and then it spread to other
10 cylinders and other PRD's acting and then becoming a
11 chain reaction and this was the outcome you know I
12 guess nine plus, it doesn't look like nine, seems a
13 lot more than nine, I guess maybe they didn't count
14 some of them, they only counted the ones there.

15 So cylinder damage and typically these
16 fires I'm told amount to four to ten million dollars
17 worth of damage so just to avoid all of those things
18 from happening I guess we want to take a closer look
19 at what the PRD's actually do. I mean sure the
20 intention is good but we want to go beyond the myth
21 and the perception and see what they really, really
22 do in an accident and to that effect we want to look

1 at the accidents or incidents where PRD's are used
2 and where they are not used, and typically in Europe
3 they don't use PRD's on propane.

4 I think UK was the only country that used
5 to use PRD's on acetylene and they have stopped doing
6 them all together so and they're generally speaking
7 they are, you never really hear of a propane fire or
8 acetylene fire in Europe. And they offer PRD's,
9 surely their cylinders are a little bit different and
10 their handling is a little bit different, all of
11 those factors have to be studied to see what role the
12 PRD's actually play in fire situations and another
13 aspect which could be tied into this study is to see
14 if a different type of storage, if we could segregate
15 the cylinders into smaller lots so that if you have a
16 little fire it is limited to one lot that can be
17 contained and doesn't speak through the entire
18 facility.

19 Another thing we can do is to, which is
20 very, very good is how the emergency responders
21 should respond to these fires. The fire situation
22 where the PRD's are used and where the PRD's are not

1 used and finally I guess the last one here is to sort
2 of go back with what Dr. El-Sibaie said earlier on
3 that we have only very limited resources so we have
4 to leverage them to be most effective and since
5 propane cylinders apparently are I guess that Plato's
6 rule applies here as well, eighty percent of the
7 flammable gas fires are related to propane, so maybe
8 we can put a little extra emphasis on looking at
9 propane cylinders because they also have the greatest
10 explosive problem and we want to get the greatest
11 bang, the maximum bang for the buck which is very
12 limited so that is all I have. I appreciate it,
13 thank you for listening I will be happy to take any
14 comments, questions.

15 MR. PAQUET: All right.

16 MR. CALDARERA: Mike Caldarera, National
17 Propane Gas Association, first I was wondering do you
18 know what the root cause was of the incident that
19 occurred in Florida, has that been determined yet?

20 DR. SHAFKEY: No, that report is not final
21 yet, but I am just going with the preliminary report.
22 Excuse me the preliminary information is that it

1 started from a PRD.

2 MR. CALDARERA: And you just mentioned
3 that eighty percent of the incidents related, of the
4 PRD incidents or assumed incidents were related
5 propane, I wanted to see where you got that
6 statistic, but the other thing I would say is you
7 talk about one of the areas of research in fact, on
8 or safety with emergency responders, our industry has
9 a pretty really strong program called propane
10 emergency which is dedicated to providing fire
11 fighters with a variety of scenarios of incidents in
12 helping the responders to respond and how to properly
13 respond from a tactical perspective.

14 There is a number of scenarios, I don't
15 recall if we have some here with regard to the
16 collection cylinders and the incident that we saw but
17 I would certainly go back and look at that, and we
18 would like to provide you information to you as well.

19 DR. SHAFKEY: Certainly you are very
20 welcome. The purpose here is, it's is nothing is
21 conclusive yet. We want input from all of the stake
22 holders which includes you and again this is not, the

1 original intent of our proposal was not to limit the
2 program at all but considering what you know you just
3 heard earlier on, we have to just sort of get maximum
4 utilization for our research dollars and concentrate
5 on the areas which have the greatest impact on public
6 safety. Steve how are you?

7 MR. GENTRY: Steve Gentry, Worthington
8 Industries, Refaat you might want to not go with the
9 person initial reports because that is not what I was
10 told in Florida occurred. On your acetylene fire
11 that was a Worthington facility and it wasn't our
12 facility, and all of our product was there and there
13 was a cracked manifold and that was the source of
14 that fire.

15 I kind of like where you are going on it
16 but none only the liquefied gasses, I would like to
17 work with you a lot on, but I have a real problem
18 with the liquefied gasses.

19 DR. SHAFKEY: I appreciate your comment,
20 as I said, nothing is done yet. We are simply going
21 to look at it and since our process and procedure
22 does require to issue proper notice to all of the

1 stake holders to get all of the time to comment on
2 these things so unless all of those stake holders are
3 on board, I mean nothing is going to be done.

4 We are simply exploring the possibilities
5 and at this stage you are very welcome to team up
6 with us and help us. We haven't given any conclusion
7 yet we have simply looked at a few things and have
8 identified something that has been a source of a
9 problem here.

10 MR. PAQUET: And again, this is why we are
11 here, to provide these comments.

12 MR. MILLER: Richard Miller, International
13 Association of Fire Chiefs and it looks like a very
14 interesting project. Certainly I think one of the
15 things as you move forward that you should look to is
16 the national standard codes and how they affect
17 storage and commodity storage and compatibility and
18 total amounts and how they can be secured and so
19 forth and certainly that, the initial reports, I
20 really like have the quantitative part in this report
21 that some of them look like they actually BLEVE and
22 that's different.

1 DR. SHAFKEY: The BLEVE comes in a little
2 later, that's when you had that explosion but when
3 you saw that little candlestick, those started off,
4 it may not have, you know Steve mentioned that it had
5 some ruptured manifold or something but at some, I
6 don't think that is clear either, because I don't
7 have a final report on that one either, but what you
8 had there on the final picture was all of the PRD's,
9 which led to the BLEVE or the explosion.

10 MR. MILLER: I also want to expand on what
11 you said, I believe you are not only looking at the
12 PRD on the cylinders and pressure vessels, but also
13 how bad these devices function, in the case of
14 propane for example, we were looking to see how CV7
15 functions, it's actually does what it is intended to
16 do.

17 MR. TOUGHIRY: Thank you Mark.

18 MR. PAQUET: Excellent, all right great.

19 DR. SHAFKEY: Thank you.

20 MR. PAQUET: And our next presentation is
21 from Bill Fink. Bill's excited because he gets to
22 tell me what to do.

1 MR. FINK: Bill Fink, PHMSA approvals and
2 permits, good afternoon all improving the safety of
3 the modern nitrate products containing ammonium
4 nitrate or products containing ammonium nitrate
5 during transportation, next slide.

6 Again remembering that our mission is to
7 protect people from the risks right inherent in the
8 transportation of hazardous materials, well something
9 about that is if you are continuously improving, you
10 have to know what your current risks are and if you
11 want to improve you have to reduce those risks, so it
12 is a continuous improvement project, right, so the
13 scope of this project is going to be bulk
14 transportation and the goal is again understanding
15 what is the current risk, explore strategies that
16 would reduce that risk significantly right and
17 understanding the economic impact.

18 In other words, such that we don't get a
19 bang for our dollar and seek input from the stake
20 holders because that is what we are after today. The
21 stake holders, what kind of risk reduction do they
22 think they may or may not require.

1 Just a couple of things here quickly,
2 about ammonium nitrate, ammonium nitrate is used to
3 make laughing gas, nitrous oxide. And the way you do
4 that is you take ammonium nitrate, you heat it up and
5 then for the next part of the reaction you spend all
6 of your time cooling it down, but there is a lot of
7 energy released and that energy that is released is
8 the energy that is of concern to us in prolonged
9 fires, next slide.

10 Okay some facts about every 53 million
11 truck miles, we have a truck fire, right, trucks
12 carry a large amount of fuel. Those eighteen rubber
13 tires, they are fixed to the vehicle and if they are
14 placed underneath the cargo they can start to heat
15 that pot up and get that reaction that we just saw
16 going and releasing that energy.

17 Truck fuel fed fires last three quarters
18 to an hour and a quarter typically and emergency
19 responders get there at absolutely the wrong time,
20 after the fire has been burning for a couple of
21 minutes, after the material has had a chance to heat
22 up, next slide please.

1 Some of the incidents that we have had
2 during the last forty two years, there has been four,
3 three fatalities in Australia, zero in Canada,
4 eighteen in Romania and you can see that there are
5 seven fire fighters and two of the news crews and
6 then in Mexico, twenty-five fatalities. This truck
7 fire occurred opposite a soccer arena and as people
8 were letting out, everybody likes to watch a fire.

9 Again, fire is the problem, heat transfer
10 is the enemy so what should we do. Fire prevention
11 most of all, can we prevent the fire. Insulation is
12 one of the methods that I thought might work.
13 Another is shielding and then any other method that
14 people would like to propose I would be very
15 interested, next slide.

16 This is a liquid hydrogen trailer, fire
17 underneath it, didn't spill a drop of hydrogen. Why,
18 it's starts with a superb insulation. One of the
19 things I would like to point out though is this
20 fender here is aluminum, it's not there anymore, so
21 again aluminum would not be one of the materials that
22 I would look to utilize.

1 Shielding, pretty effective, pretty cheap,
2 pretty low tech, right, oil filled fire, and you have
3 a couple of guys standing behind the shield and they
4 are protected from the fire. Shielding is a really
5 interesting passive, inexpensive way to maybe
6 accomplish this but again we are going to have to do
7 some calculations and make some determinations, next
8 slide.

9 Other things that we could do, reduce the
10 mass of the fuel, super singles, right less rubber,
11 in the road, and then distance the tires and fuel
12 from the combustibles. I picked this particular
13 cargo because sometimes the bad example sometimes is
14 the best. You see this is what I would call a
15 Michigan truck, lots of the axles, if you have been
16 up in Michigan they put the eleven, twelve, thirteen
17 axles underneath the vehicle so lots of axles, lots
18 of rubber underneath the cargo space so I would
19 expect that not to be a good design, next slide.

20 So some of the deliverables from this is
21 we would like to see strategies for consideration,
22 some of the energy calculations that go with those

1 strategies, what's the additional costs, what are the
2 reduced risks, right again getting no bang for our
3 buck and then proof of the concept and absolutely,
4 absolutely stake holder input because the stake
5 holders are the people who are going to have to help
6 us make some decisions so thank you. Question?

7 MS. HILTON: Cynthia Hilton with the
8 Institute of Makers of Explosives you are very brave
9 to stand up there and say those things. Our industry
10 consumes 75% of AN who represents the largest
11 manufacturer of this product in the United States.
12 We are very much opposed to this. We are struggling
13 to find out why with your limited resources that this
14 would be a project you would put forward.

15 Going back forty-two years wow, the
16 incident in Mexico, it's so discouraging to think
17 that you all think the incident in Mexico, that was
18 Amco, it's a 1.5 and if that hasn't happened in
19 Romania, hmmm, anyway you should come talk to us and
20 we will tell you what we know about these incidents
21 but in the United States you had no deaths ever from
22 this, this is one of the safest products.

1 We have saved lives in the transition from
2 nitroglycerin based products to AN and you all should
3 be given us an award so we have huge issues with this
4 thing, we just, if you want to look at fires and risk
5 and saving lives, it's not AN you need to be looking
6 at.

7 So I would love someone to explain to us
8 so I can explain to our industry why you have focused
9 on this product. I know that maybe it's politically,
10 and you know I seem to be talking to that now, but
11 can we hear back from you on that.

12 MR. FINK: Yes, well I think one of the
13 things we want to look at is the ammonium nitrate and
14 ammonium nitrate contained materials are inside this
15 scope. Secondly I think we have to look at the issue
16 at West Texas last April 17th and wait for those
17 results to come out before we can move forward. Also
18 we are seeking.

19 MS. HILTON: A limited amount of money,
20 really West Texas.

21 MR. PAQUET: It's only a proposal.

22 MR. FINK: That's correct.

1 MS. HILTON: I though what we are here, is
2 this not what the scope of work is for the next
3 twelve months?

4 MR. FINK: Right so we could elect not to
5 do this scope of work or we could elect to do it. I
6 would like to hear from you on that, right, yes.

7 MR. STEVENSON: Boyd Stevenson, American
8 Trucking Association. I will not repeat Cynthia's
9 comments except to say that we share the same
10 concerns. Also just want to note that I have
11 struggled for many of the reasons that Cynthia has
12 identified to see how some of the areas that you are
13 looking into as far as proof of concept could be used
14 in any sort of way to demonstrate any sort of benefit
15 that would outweigh the costs and I just haven't seen
16 that fortuitously makes me wonder whether or not this
17 research is necessary, given that we already know
18 that there are very few societal costs since we
19 haven't had incidents.

20 MR. PAQUET: And that's exactly what came
21 back, a proposal, we are in that section of the
22 program today, so if the covent to the proposal is we

1 don't think we should go through with this because
2 there is, provide us with input that's great.

3 DR. COVINO: Josephine Covino, Department
4 of Defense the Safety Board, at first I wasn't going
5 to say anything but I do have to say something that I
6 do think fire and shielding aspects, whether it is on
7 a transportation truck, whatever the material is, for
8 example, let's take that hydrogen fire that you know
9 the tires were burning, blah, blah, blah, you don't
10 know from a fire fighter's perspective how close
11 those fire fighters who fought that fire were to
12 almost being killed. For them to have put their
13 hands in harm's way I actually think these kinds of
14 experiments are worthwhile to understand.

15 Because hazardous materials a lot of them
16 are very flammable, understanding the time dependent
17 of that fire so that the fire fighters could fight
18 the fires so you don't make the whole city a problem
19 I think is very important. However, you scope it,
20 that's my big question but I do think the time
21 dependence of the fire events is important.

22 MS. ABDELKADER: Sarah Abdelkader I am

1 interested in getting this comment because I
2 appreciate what you said about the fatalities and
3 according to your span in looking at the data, but
4 what I am missing to put it in context is in contrast
5 with what, so when you made that comment I was
6 looking for, but here is a suggestion for what you
7 should focus on so that I can protest. Like there is
8 a lot of fatalities in that commodity, so why don't
9 you look at, because this has a lot of fatalities,
10 injuries in the U.S. this is what you should do
11 because basically to me as a risk analyst, what you
12 are saying this is a low risk, you shouldn't spend
13 time or research money on it, this is a high risk, go
14 for that.

15 MR. PAQUET: You don't need to respond.
16 We've been having this conversation back and forth
17 right now, but what I will say is that just last
18 year, because last year we put out some research,
19 what were are top risks, cargo tank rollovers was top
20 and flammable liquids and so certainly your comments
21 are very valid Cynthia and we can, I am saying that
22 there is very little risk, I got you, but I just

1 don't want to get into necessarily the back and forth
2 because it is not productive. It was a very good
3 question.

4 MR. FINK: Yes absolutely.

5 MR. PAQUET: Actually listening to the
6 debate and not being an expert, you posted it in
7 question form in my mind was pressed either now or
8 later for a personal answer and how do you set the
9 priorities and create the agenda of the research
10 topics that you want to consider because maybe that's
11 what we are really getting at is if we are going to
12 spend research dollars, how do we make sure they are
13 prioritized to that special program.

14 Now if lack of insulation or if there is
15 demonstrably a big program around ammonium nitrate
16 transport then it should be of high priority. If
17 there are other things that demonstrably have bigger
18 problems then they need to be a higher priority so I
19 would like to see if you could comment about it at
20 some point.

21 MR. RICHARD: Previously being a regulator
22 and working here at PHMSA, it's not always, I mean I

1 had industry people saying they were not having
2 accidents, why look at this, it's low probability,
3 high consequence. So I think with this issues I am
4 not saying whether it is a high consequence or not,
5 but you know that's the part, I don't know if anybody
6 has ever proved that so that's the issue. I'm not
7 convinced because hey we are not having any actions
8 so we don't need to look at this.

9 There are limited resources, it is
10 difficult to pick the projects, but I think the high
11 consequence and low probabilities are part of the
12 equation.

13 MR. PAQUET: I think that there is a lot
14 of opportunity for constructive comments on this
15 specific one.

16 MS. HILTON: I want to make a constructive
17 comment here which is we should be looking at risk.
18 We don't have an unlimited pool, I think you would
19 agree with that, a limited pool, we should be looking
20 at risk and there is risk out there but I think you
21 should go back and look at the data, it is not one
22 particular product, none, so just focus on that

1 because there was an industrial accident where no one
2 followed what is best practiced, you know West Texas,
3 there is a total lack of what anyone in our industry
4 would say this is how you manage this product, you
5 can expect bad things to happen.

6 You can't you know, what do they say, you
7 can't live like.

8 MR. PAQUET: I don't want to use the word
9 stupid.

10 MS. HILTON: You can't legislative stupid
11 but you know if you follow the rules and the best
12 practices you are not going to have these problems.
13 We do looking at West Texas, now recommend when a
14 fire has engaged AN you do not fight this fire. We
15 just put out a video for the fire fighter community
16 with the endorsement of the International Association
17 of Fire Chief's saying thank you very much and it
18 speaks to this issue, we are trying to save lives, to
19 Jo's comment about how close should they be. We have
20 been watching the fire report, not AN, you know
21 because that is our product and if AN is concerned,
22 and we do get concerned because the fire fighters get

1 too close and we believe in training and we would
2 like to keep those people out of harm's way.

3 MR. PAQUET: Thank you.

4 MR. FINK: Nobody is asleep.

5 MR. PAQUET: Nobody's asleep anymore,
6 excellent.

7 MR. FINK: Thank you very much.

8 MR. PAQUET: What is going on here, all
9 right our next presentation Dr. Steve Hwang.

10 DR. HWANG: Good afternoon, it looks like
11 we saw enough fireworks and explosions so it's about
12 time to change gears. What I am going to talk about
13 is the slide large format, lithium batteries. It's
14 not a proposal we have an interagency agreement with
15 Navy research center right now to fulfill this task.
16 It lasts until 2015 and after that we need to have
17 further proposal to continue and of course a large
18 format lithium batteries, I tend to speed up a little
19 bit later but if I do it, you know, keep me, let me
20 slow down.

21 Large format lithium batteries have a
22 unique challenge in managing risk in transportation.

1 Why because large means big, according to the UN
2 definition, large means anything greater than 12
3 kilograms and I, you know 12 kilogram is you know if
4 you envision how big that could be about this size
5 battery that is about 12 kilograms but if you look at
6 automotive batteries, like a maybe a hundred or a
7 couple hundred kilogram size. Of course if you look
8 at different applications you can have a couple
9 thousand kilogram batteries as well in different
10 applications like in let's see, in military
11 applications they have these huge batteries for
12 mounting on ships, et cetera.

13 Or even they even use the international
14 space station, I was in Houston, Texas too, they are
15 concerned about the use of batteries and the safety
16 of batteries. Of course you know about the use of
17 batteries in aircraft et cetera.

18 So the second reason why it poses
19 challenge is because the lithium batteries have high
20 energy density per unit kilogram, per unit weight.
21 That is the beauty of the lithium battery to begin
22 with but at the same time it causes hazards. So in

1 terms of not only chemical hazards, but also
2 electrical hazards, it can short circuit, not only
3 short circuit but also because of chemicals it can
4 burn or it can run or have what's called a runaway et
5 cetera.

6 So our purpose of this research is right
7 now is to, I mean in a broad sense, I am going to go
8 into specifics later, but to have safe batteries when
9 you transport them for large batteries. Of course
10 more batteries too you know we want to make sure that
11 they are transported safely.

12 We also receive a lot of the
13 manufacturers' concerns. I do many a variation of
14 many approvals and we want to make sure that those
15 concerns are investigated so that manufacturers can
16 be in compliance, next one please.

17 So what we have right now ongoing in terms
18 of research program is I have five highlights here.
19 One is concerning battery testing, that is, I mean
20 there are eight battery testings you have to do in
21 order to meet the important UN test requirements and
22 we are going to go into specifics one by one later.

1 Second one concerns, let me see, the
2 hazards associated with transporting batteries by
3 aircraft. Aircraft we had about a hundred accidents,
4 incidents I would say on aircraft in the last fifteen
5 years, the reason batteries on the market about
6 fifteen years ago, it's not, before then there was
7 some other batteries, but we only have the incident
8 report on aircraft, we don't have any incident report
9 by motor vehicle or any other modes because it wasn't
10 required, reporting wasn't required until about a few
11 years ago.

12 Third one is we want to have some
13 procedure developed for doing some forensic analysis
14 of batteries, on failed batteries because if a
15 battery fails then instead of looking at the source
16 of the batteries, you want to have examined the
17 interiors of the batteries by using x-rays, or CT
18 scans to understand what is going on inside the
19 batteries.

20 Fourth one is the project concerning
21 prototype lithium batteries. As some of you know the
22 prototype, regulations concerning prototype issue

1 lithium batteries are kind of loose. At the UN level
2 of course, you know HMR is taken from the UN
3 promulgation and that is a common practice here so
4 that we can harmonize the regulations and in doing so
5 creates a lot of problems because you know, it can
6 have, the approvals can have different transportation
7 requirements because we do it on a case by case basis
8 so something that the Navy uses we are trying to look
9 at in terms of specific approvals being issued.

10 Fourth one, I'm sorry fifth one is we want
11 to look at some kind of case study as to how we can
12 do this forensic analysis when you have failed
13 batteries, next one please.

14 Of course there are many applications of
15 these large batteries, in terms of automotive and the
16 military applications and of course they use some of
17 these batteries in storage of energy, et cetera, and
18 aircraft and also at the space station I mentioned,
19 next one.

20 That's a huge battery about the third size
21 of this battery that they used for radar for Navy
22 applications. So in order to have the outcome of, we

1 just indicated, these are specific tests that the
2 Navy research center has to do and we will go through
3 these each one by one, next one please.

4 Since I have only ten minutes I cannot go
5 through, read all of this. This is the test or
6 procedure we were looking at. The test procedure we
7 need right now we have to issue at the UN level as
8 far as I know is what is called the shock test, among
9 other tests. People say you know all of these tests,
10 the tests are not perfect so they are examining all
11 of these one by one right now but the shock test is
12 the one which is being looked at pretty closely, so
13 that's one we just finished at the Navy research
14 center, I will go through some of the equipment
15 apparatus and what we need et cetera.

16 And we finally have to look at the current
17 the requirement in terms of what is called, in terms
18 of shock test, in terms of the acceleration, G force,
19 G force of Earth is 1 G and then right now for small
20 batteries it requires 150 G for large batteries it
21 requires 50 G. It is not a separate number, it goes
22 with what is called the postulation and I was

1 supposed to bring a battery but I didn't I'm sorry so
2 I am going to use my mobile phone battery.

3 Before I show you the equipment we use,
4 basically they do, you can do, it's called the shock
5 test by two ways. One machine they can use is what
6 is called the shaker or vibration machine, in
7 Maryland they have that and we did the test at that
8 facility and the test is expensive.

9 More easier and a common way of doing is
10 what is called the drop tower. Simply you drop the
11 battery at certain height on the floor, whatever the
12 surface would be. I should stay here of course I'm
13 sorry. So, no that's all right, so basically you drop
14 this battery on the floor and before I go through the
15 specific examples, since we have all this endurance
16 in the morning and also we might be a little groggy
17 now so I want to give you an example, a test.

18 If I drop this here on the floor what kind
19 of G force and postulation do you think you can
20 expect to have? I dropped it, what kind of G force
21 and postulation did this battery get? G is, I'm
22 sorry, G force, this is approximately for the, this

1 is small, it is not big battery, small battery, the
2 climate is it has to meet 150 G and 6 milliseconds
3 and this about the force you are going to encounter
4 so if I see a fire, or damage et cetera it's fine,
5 that's with the shock test, but if you have a huge
6 battery like this and if you drop it from here to the
7 floor, it's pretty high and what kind of G force do
8 you think you would get? It's not the same G force.

9 What it is-is if you drop it on the floor
10 like this unless you change the floor, postulation
11 doesn't change. It's about 6 milliseconds and not 11
12 milliseconds. It has to be softer than this to get
13 11 milliseconds. 6 milliseconds and if you drop the
14 battery like this from here to the floor the G force
15 will be instead of 150 G it would be around 50 G.

16 What I said was that as mass goes down at
17 the same height, G force goes down so that's a
18 problem industry is facing with, in other words, what
19 I am saying is if you have a, I drop this like this
20 and it is 150 G, and if I take a big one here like
21 this it is 50 G but in order to bring, it could be 40
22 G, let's say it's 40G instead of 50 so in order to

1 make it to 50 G you have to raise the height of this
2 and then as it goes bigger and bigger you have to
3 raise quite a bit and then you damage the battery so
4 that is the problem they are looking out.

5 So I'm sorry I don't want to go into too
6 much of this so let me go back, so what we want to do
7 is we want to keep the operation of this battery
8 within this range, this is fourth inch temperature
9 scale, you have heard about this, I don't see any
10 battery experts here actually so if you heat the
11 battery above 100 degrees anything, a lot of things
12 could happen, there is acetylene inside here it could
13 melt and also a lot of things could happen, this
14 could happen if the battery would burn, it happens a
15 lot of times, in many cases.

16 And this is the instrument that we used at
17 the Maryland research center and this is the 16
18 kilogram, 75 pound battery and there is a lot of
19 wires here for instrumentation. This is a fireproof
20 chamber in case there is a fire we want to contain
21 that is why it is a fireproof chamber and other
22 things in mind, remotely, this is for my computer

1 screen as you can see, you can measure the G force by
2 using the computer monitor and using spirometer, a
3 spirometer is a small device you put on the battery
4 and when it hits acceleration G's actually if you
5 remember it is a change of velocity with respect to
6 time, that is what acceleration is.

7 If you attain certain velocity but
8 velocity is not G, the change of velocity with
9 respect to time that is what the G is and then to
10 various things using this monitor. That is what the
11 computer does, so and that is a test part. Another
12 part we want to look at is the radius, right now the
13 35 kilograms is the radiant for transportation on
14 aircraft and we receive a lot of this for exceeding
15 this weight.

16 People say it impedes the ability to
17 transport and they are trying to look at the various
18 factors like battery manual system, state of charge
19 and the packaging et cetera and whether they will
20 need to improve the overall safety of the
21 transportation, next one please.

22 This is of course the forensic analysis

1 you get to look at the inside of the batteries to see
2 whether we can really determine the cause of the
3 failure in terms of the components by tracing the
4 components and of course some of the test method
5 which is lacking right now is what is called internal
6 short circuiting, nobody came out with a method yet
7 because they don't know how to do it yet, so by
8 looking at the internals maybe they can figure out
9 what happened to it and this is the prototype
10 batteries, we tried to examine what the CA's
11 approvals ratio there regarding prototype batteries
12 so that we can have some consistent requirements and
13 those are not to duplicate the approvals for similar
14 designs and marketable issuance of approvals for
15 international shipments.

16 This is a large packaging. We want to
17 look at large packaging in terms of how we can
18 improve the failure mode and not only to prevent them
19 on the runway, but also we try to look at the fire
20 suppressant, right now halon only is fire suppressant
21 that is allowed and we are trying to make a different
22 fire suppressant as well.

1 And this is case study to look at the
2 failed batteries in terms of the new codes analysis
3 and fire safety et cetera.

4 This is well there are a lot of things
5 that we can look at later on. This gives you an idea
6 of some of the areas we can look at, it's a full area
7 and I don't know, you know, that's why we have this,
8 I thought we have this forum to get some input from
9 the public and some of the things that our contract
10 that we came out with looks like. So we have to
11 study in the next phase, this is not under contract
12 yet, and study the effectiveness, different kinds of
13 material being the promulgation I think that is
14 something, and investigate the use of hydro
15 fluorinated electric as a suppressant and also maybe
16 the mixing material within the battery et cetera.

17 And what we also, we don't want to stop
18 the investigation of the battery failures because
19 right now there are a lot of issues associated with
20 that, thank you.

21 MR. PAQUET: Thank you Dr. Hwang, that was
22 excellent, any questions on lithium batteries?

1 MR. RICHARD: Can we go back to the slide
2 that has the objectives, the outlines, it was the
3 first or second slide that had the different
4 components of this research so the purpose of this
5 meeting is to try to influence it or get comments on
6 it, so if I look at this and thank you Steve for the
7 presentation, next one this one right here.

8 So first of all my first comment would be
9 this is very, very blunt and I think what I liked
10 about the presentation was talking about the shock
11 test because I totally agree you know, that there
12 needs to be work there. Actually there is an
13 organization called Costa, you are well aware of you
14 guys were there this week and they have a proposal
15 that they are going to submit to the Brussels meeting
16 that is going to be held.

17 DR. HWANG: I saw that yes.

18 MR. RICHARD: But perhaps some further
19 research would be helpful there because it is not
20 totally perfect. I have a real concern with this
21 piece of forensic analysis. I work with a company
22 called Exponent and I am going to call it, these

1 companies have research scientists on their staff
2 that are very intently accommodated and they do
3 forensics on a daily basis for all types of companies
4 and I really think, I don't think the research
5 dollars will be well spent by trying to standardize a
6 method for conducting forensic analysis because there
7 is many ways to do it depending on the battery
8 design, the battery chemistry, the size and so I
9 don't know if it could really be achieved here I
10 think there are people that are very good at doing
11 that already and perhaps you should talk to them
12 before you do further research on that.

13 As far as the packaging, I'm working with
14 a company called Americase, we were actually invited
15 to speak at their meeting and we have a packaging and
16 there is other manufacturers out there, our
17 competitors that have packagings that contain a
18 thermal runaway of the batteries on the packaging and
19 there is a pending approval that you guys have with
20 one of these packagings.

21 So the technology is there, I am not sure
22 of research in that regard would even be worthwhile

1 because there is so many different things that we are
2 looking at right now, we have different materials,
3 materials that you can actually put in, that is
4 similar to packaging peanuts that when they are
5 exposed to heat they will actually melt and consume
6 the battery and some other things, so there is a lot
7 to do.

8 I think this is overly aggressive and
9 maybe you should narrow the focus of that research to
10 something that is more tangible that you can achieve.

11 DR. HWANG: Let me.

12 MR. PAQUET: You are out of time, maybe in
13 the second part. So thank you very much Steve I
14 appreciate it. We are actually going to go through
15 Joe Nicklous's presentation and then we will take a
16 break, just keep going well we will see. We don't
17 know how Joe's going to be.

18 MR. NICKLOUS: Thank you sir, all right
19 glad to see everybody made it back this afternoon and
20 it has been energetic to say the least. So, the
21 odorization of LP gas, liquefied petroleum gas, it's
22 my second topic of the day and there is some concern

1 regarding odorization. There have been incidents and
2 instances where the odorant of an odorized LP gas has
3 "faded" over time given the chemistries involved.

4 There are multiple chemistries, they are
5 all listed within the section of the regulations that
6 is on the screen. There was a specific incident in
7 Massachusetts supposedly odorized with ethyl
8 mercaptan but the big question is why study
9 odorization.

10 We want to determine the absolute cause or
11 multiple causes of this odorant fade phenomenon. And
12 it is important because unodorized LPG is odorless
13 and presents pretty big dangers. So when you get it
14 into the hands of consumers and end users, you don't
15 want to necessarily have an unodorized LPG.

16 So next slide, so far things that we do
17 know. Steel cylinders, tanks are subject to
18 oxidation. Oxidation appears to occur regardless of
19 the state of the cylinder. Continuous use seems to
20 have desensitized or deactivated reaction for this
21 oxidation however it is present in all typically more
22 show faster oxidation rates due to the deactivation

1 aspect, not a hundred percent sure of all of that so
2 part of the reason why this is on the table for at
3 least thought and consideration.

4 This is the incident that garnered a lot
5 of public interest into this specific topic. A quick
6 summary, July 30, 2010 seven injuries, one fatality,
7 liquid samples confirm virtually no ethyl mercaptan
8 present in what was termed, or deemed to be a
9 odorized LPG gas.

10 So these are just the recommended or
11 thought about areas we hope to identify or at least
12 ask questions on. We know there has been a lot of
13 research that has been done, I know it goes back
14 roughly thirtyish years. It's hard to get an
15 accurate snapshot of everything that is known about
16 this area so first and foremost, what has been done,
17 what's changed since then, obviously new
18 technologies, new different chemistries, linings to
19 tanks et cetera.

20 Determining the effectiveness of the
21 "sniff" test, is there a better way to come up with
22 is the gas still odorized. Is it odorized

1 sufficiently and then are there ways to prevent the
2 current odorants from this fading aspect. Is there
3 an additional additive to slow down the oxidation?
4 Is there a potential new odorant out there and there
5 are and we realize there are some serious issues to
6 identifying a new odorant and all of a sudden
7 recommending the use of a new odorant and first and
8 foremost on those I would say you would have to train
9 the entire American public that natural gas wouldn't,
10 gas wouldn't smell like "gas" if it doesn't have the
11 same scent to a human.

12 You would also have to get something that
13 would be as humans are as sensitive to. It would
14 have to be unique, you wouldn't want to encounter
15 this all of the time and think you are smelling gas.
16 Potential but we realize there is a lot of concern
17 there.

18 The last question is, is there a way to
19 condition the newer un-deactivated steel from
20 speeding up this oxidation process. Is there
21 something that you can treat the steel with that
22 would slow it down? So there is some really

1 beginning discussions, there is nothing really hard
2 and fast this is kind of just a thought provoking
3 discussion but we do realize that there is a concern
4 there, there is a risk there and we want to look into
5 potentially stopping it from happening again.

6 MR. PAQUET: Thank you Joe.

7 MR. CALDARERA: Mike Caldarera, National
8 Propane Gas Association. One think Joe I think can
9 we agree that this issue is limited to rail cars and
10 not over the road trucks because those incidents that
11 we have seen, the issues we have seen with odor fade,
12 you know in the last year, a couple of years is
13 really confined to rail cars, we have nothing related
14 to over the road vehicles.

15 MR. NICKLOUS: I think we can agree that
16 the incidents that have happened have been involving
17 rail cars but I think it also extends to any
18 potential steel cylinder, steel containment vessel
19 that is out there, we do have the storage tanks as
20 well as the rail cars. I wouldn't say it's a, the
21 five pound canister or the you know the propane
22 canister you use in your barbeque grill, it would be

1 the primary concern because you are using it fast
2 enough that the odorant fade doesn't have a chance to
3 take effect.

4 This is more I think it is more
5 fundamental, just in general the chemistry. Is there
6 anything chemistry involves that we can stop the
7 fade, slow it down, prevent it from happening,
8 identify a new chemical that wouldn't have that
9 property of oxidation and "therefore fade".

10 MR. CALDARERA: Part of it is when you
11 look at the rail cars, there are occasions with rail
12 cars, you know after they get loaded on they may sit
13 on the side for some period of time so they would
14 have some stratification maybe some of those
15 phenomena occur in addition to what you had mentioned
16 before. You don't really see that as much with once
17 you have bulk plant or at a consumer tank, because
18 those are typically filled and refilled enough so
19 that you don't get that stratification so it is sort
20 of less of an issue and also it is a new issue with
21 older tanks, clearly is the newer tanks, or those
22 that have been in a different service, hydro or more

1 properly cleaned so those are the phenomenon. You
2 also referred to there has been a lot of work and
3 studies done on this and it certainly behooves to
4 revisit that someone necessarily duplicated.

5 With respect to a new odorant, I mean
6 anything is possible, I can tell you I think ethyl
7 mercaptan over the years, and I'm just saying this
8 anecdotally from what I know that ethyl mercaptan is
9 proved to be the best odorant and I think it is
10 detectable down to .4 parts per billion or something
11 so and even as it is now it is not necessarily a
12 mandated again in regs or in codes, it is typically,
13 that's become the accepted practice so that's where
14 that stands and unless we had something new, you had
15 to go through all of the retraining and that sort of
16 thing.

17 It's hard to get your arms around it we
18 know it's out there. It's not, I wouldn't say it is
19 as common an issue but the fact that it is an issue
20 remains and we do need to look at it.

21 MR. NICKLOUS: And I think that's exactly
22 the point of the research is that primarily the

1 literature review about what's happened before and
2 then what's changed since that's been done, if there
3 is anything to update.

4 DR. WONG: Kin Wong, I guess maybe it's
5 time I say something. There was a chemical, it was a
6 fortune 500 company that made chemicals and I have
7 the guidance call for customers that I had in the
8 company twenty years ago and it was well recognized
9 at the time that this fading, especially one against
10 pneumatic pens and the guidance was to, when you put
11 in the odor you have the mental detection to make
12 sure that you have concentration in there, so maybe
13 another approach is better packaging for to check,
14 to make sure that what you put in is there you know
15 and it does the job and that was in effect for many
16 years and the high material available and it is cheap
17 and has been effective as an odorant.

18 MR. GENTRY: Steve Gentry, Burlington
19 Industries, I am an old propane guy too. There are a
20 lot of good reports starting back in 1976 on odor
21 fade. That started back then it was the NLPGA, the
22 National Propane Gas Association had another name

1 back then. They got in trouble with the golf
2 association. Anyhow, if you go back in there you are
3 going to see there have been studies done all the way
4 since I was first involved in 1975, up to today.

5 I agree with what you were saying about
6 ethyl mercaptan, we looked at different odorants, the
7 Sheriton Hotel in Charleston, South Carolina,
8 somebody knocked the bottle over and we had to
9 evacuate the Sheriton Hotel, I think, but I would
10 like to share with you Dr. Roberts report will tell
11 you when you look at steel tanks, the issue is not
12 the steel tanks, the issue is the water wasn't taken
13 out of the steel tanks and you have to pretty much be
14 a metal artist or get involved into the chemistry of
15 it, what you will find out that it is not a FE203
16 issue, it is an FDO issue, it's not rust in the tank
17 that causes problems, as you know there is red rust,
18 it's before it turns red and it might say, and I've
19 done product liability on odor fade since 1971 and I
20 can tell you we have never had an odor fade in the
21 sulfur, never once had an odor fade in the sulfur, we
22 have been accused of it, but you had an odor fade and

1 recalled tank cars and my gut feel is there was, I
2 think there is a problem getting the water out of
3 these old rail cars, that is just a gut feeling, I
4 can't prove it but I think you really have to look
5 into it, this thing has been looked after for 40
6 years now.

7 MR. NICKLOUS: And again that's, I think
8 the primary starting point is doing the literature
9 search, getting it all in one spot, review it all and
10 see if there is anything that has changed, see if
11 there is anything that can be recommended on the
12 practices, is it strictly to rail cars and/or storage
13 tanks as well, things along those lines.

14 MR. GOLDSTEIN: Yeah, just a general
15 comment on this issue. I guess a little bit is part
16 of the culprit and compliments to you for this. The
17 IFC and the National Association of State Fire
18 Marshals got involved with this. The incident up in
19 North Mass that you mentioned back in 2010, the state
20 fire marshal up there came to IFC and they changed
21 their rates from a C test to doing 2 testing and so
22 there was that issue and we were aware of a lot of

1 the different studies that have been done.

2 We filed comments with the Consumer
3 Products Safety Commission to get into their plan,
4 into their budget and candidly they were basically
5 blowing us off and not even met with us so we think
6 this is a worthwhile project in the recognition of
7 all of the projects been done, we have met with Mike
8 and his colleagues at the Propane Gas Association.
9 For the purposes of today I really want to compliment
10 PHMSA, you guys have really been open to discussions
11 for this issue and Chief Butters just walked in, we
12 weren't supposed to notice.

13 It is something new though but you guys
14 have really been in the forefront of this so I really
15 want to thank you for even addressing this potential
16 issue. We do think it is important and a lot of our
17 membership does and the fire marshals because of the
18 fact that a lot of studies have been done, but
19 somehow it is still happening or has occurred and it
20 is one of those things where it doesn't happen a lot
21 but when it does it has a big impact obviously so
22 really on this point we will be filing comments

1 hopefully that you will take this one.

2 I just really want to compliment you
3 because you are about the only agency that even wants
4 to see us anywhere and talk to us so compliments to
5 you all.

6 MR. PAQUET: Thank you.

7 MR. NICKLOUS: I think the other important
8 part of that is to get some of the people that have
9 access to those reports currently to send them in as
10 part of the public comment period because we will be
11 happy to look at them at that point, as soon as I get
12 my hands on them.

13 MR. GOLDSTEIN: I apologize.

14 MR. PAQUET: You are pushing my time limit
15 here.

16 MR. GOLDSTEIN: I know, that's why I
17 didn't want to take a break. By the way, having said
18 all of that with what Mike said and this other
19 gentleman, we are probably not in any material
20 disagreement in where you have to look even though I
21 do think we would still say probably the rail seems
22 to be where the focus has been but part of that is

1 some of the incidents they found in Massachusetts
2 because they were looking at the rail and they are
3 doing the tube test, so you want to talk about a
4 sniff test, we would love for you and we will do it
5 with comments, say look at the tube test as an
6 alternate and what do you think of that.

7 Probably the new odorant, I probably agree
8 with Mike that that's probably one where we don't
9 think that I would spend much time with any. I
10 really think that's we have heard rumors that some of
11 the imported may not be as good as the domestic but
12 again that is all speculation and my sense too and it
13 is dangerous when somebody who does government
14 relations has a sense, but part of it is the steel
15 tanks, the water, possibly linked to time sitting on
16 a rail car where trucks normally don't, but at least
17 from our standpoint we would not exclude a truck Jim
18 Goldstein with the International Association of Fire
19 Chiefs.

20 MR. PAQUET: All right although I was
21 requested not to take a break because our W8
22 administrator is here, I figure it's time to do a

1 break, eight minutes, an eight minute break.

2 BREAK

3

4 MR. PAQUET: All right I want to set some
5 ground rules for the rest of the discussion today.
6 It is going to be more open. I am still going to
7 limit you guys to five minutes okay, so there's that
8 time. Understand that I will be hovering around you
9 and when my timer goes over at five minutes maybe
10 even a little before that, I'll tell you it's time to
11 wrap up.

12 Please, please, please provide
13 constructive comments. Do not expect a full on
14 conversation and certainly don't expect to hear
15 something that is the official word of the Pipeline
16 and Hazardous Material Safety Administration because
17 although Deputy Administrator Connors is here we are
18 still not in that position to do that in this forum.
19 So please do not ask us a question that is going to
20 put us in a corner. If you ask a question that puts
21 us in a corner, for whatever reason, I will
22 intercede, just letting you know.

1 Don't set expectations please this is a
2 productive and constructive communication. Provide
3 comments that we can act upon. If there is something
4 that you say that "Oh my, that's a terrible idea,
5 please don't do that project". That is a comment
6 that we do not act upon. We cannot do that project
7 and that is a constructive comment. If you say what
8 in the world are you thinking is horrible and I need
9 you to answer me right now, the answer is going to
10 be, thank you very much for the constructive
11 comments, let's move on. So I am just setting the
12 ground rules, setting the expectations.

13 All right Carole and Lucy are up here,
14 they will be heading up most of the responses, I am
15 sure that they can defer to whoever they want, but
16 you may not respond, because if it is just a
17 constructive comment the response is going to be
18 thank you very much for that constructive comment,
19 okay.

20 So the floor is open. I assume that there
21 will be plenty of hands so please, the floor is open,
22 unless you guys want to start.

1 DR. LEBLANC: Would that be okay if I
2 started with some lessons learned that I would like
3 to take away from this. Thank you very much.

4 Okay first thing I heard today is
5 duplication appears to be very important to most of
6 you people, just about everybody in this room. So
7 what we are going to do is make a list of the
8 projects that you have all heard of today and meet
9 with Charles Spence and his staff in particular to
10 make plans to determine how many aren't related to
11 other things that are going on in the globe, I would
12 imagine that many of them are.

13 The second thing I am going to do is
14 obviously promote the tech divisions in person
15 engagement with overseas events and I know how
16 difficult that can be sometimes in terms of limited
17 travel. That seems to be the only way to really
18 ensure that that takes place.

19 The second thing I learned today and that
20 is about Tim. I have heard enough about Tim to
21 realize that that is something we just have to nail.
22 I admire they have this science drive the policy and

1 the other way around, so we just have to do that, we
2 just have to lay out that test and just get her done.

3 The other thing I think I've learned today
4 is that we are delighted with the industry
5 engagement, you are a very important staple to us but
6 I think we have to work harder for the other stake
7 holders like first responders, other first
8 responders, those kinds of stake holders that perhaps
9 have very limited travel budgets. We went through
10 the same problem with HM Access we are just going to
11 have to work harder on that.

12 On a personal note, we have recently gone
13 through a number of retirements and tragically a
14 death. We have recently promoted Joe Nicklous to
15 Chief and so I would like you all to consider Brian
16 Vos to be a very important contact person and lead in
17 the explosives program and then finally the process.

18 A lot of these projects came about as a
19 consequence of the interim work that PHMSA was doing,
20 especially with Ryan's group and what we see saw was
21 our workload and problems coming up over and over
22 again. So although this is the first R&D Forum, what

1 are some of the suggestions we could do going forward
2 in making sure that we keep this engagement,
3 especially in terms of prioritizing these projects.

4 So I'm thinking at the very least we need
5 to meet more on a routine, maybe less formal way and
6 have within six months, sort of an update session,
7 whether or not that is you know, as a teleconference
8 so that you all understand that we have listened and
9 we are going to make adjustments to these research
10 projects.

11 And then finally how do we select the
12 projects with such limited funding. Who is going to
13 make the decision about what is high risk, what is
14 low risk and all of the things that go in between and
15 so I have some familiarity with that with the state
16 program, I don't know there is a couple of you from
17 Massachusetts, we have done similar things with
18 industry there, that led to the Kennedy Award,
19 Innovations and Government Award from Harvard, where
20 we actually did compose together the Toxic Use
21 Reduction Act, or TORA and those components that were
22 agreed upon by make stake holders.

1 And then I recreated that same process of
2 decision making for the Pentagon in terms of their
3 decision making processes for the treatment of hazmat
4 and the right of those policies. So those are some
5 of the things that I am just thinking about going
6 forward.

7 I don't know if any of you are familiar
8 with the solvent alternatives or solvent substitution
9 workshops that came out of the Clean Air Act but EPA,
10 of course at that time, the significant new snap
11 program and those were some of the processes that we
12 may want to look at in terms of decisions going
13 forward together. I think I have probably said too
14 much, but I just wanted you to get a heads up on what
15 I was thinking.

16 MR. VOS: Thank you.

17 MS. HILTON: Cynthia Hilton, IME. First
18 of all I want to apologize to everyone and I did
19 apologize to Bob, that was not the best but anyway I
20 am really grateful, I am that you have held this
21 Forum. We support this program, we support MAP-21
22 provision, we want you to be successful and I'm glad

1 you are listening to us.

2 I do want to say some comments and respond
3 to a very good question and a point that Jo made. So
4 Texas City, Fort Neil, Oklahoma City and West Texas
5 are not products for our industry. So when you look
6 at bad things, I'm sorry the context is ammonium
7 nitrate, those are not products for our industry. We
8 manage these products differently and again, we
9 consume 80% of that product.

10 Billions of pounds of this stuff is used
11 and manufactured every year. Not one AM is used at
12 the site that it is manufactured. Transportation is
13 a huge important component of that. So one of the
14 things that you need to look at for the people who
15 are asking about risk is what is your exposure?

16 This particular product project let's
17 look at tractors and trucks 80% of AM goes by rail.
18 50% by trucks, 5% by barge so again if you are
19 looking at exposure, maybe you should have a rail
20 project on this.

21 And the threat -- maybe we should go back
22 and look at your data, because we love your data, we

1 love your data. So '73 since the beginning of time
2 there has been 139 truck fire incidents with 5.1
3 product and none were AM and since 1973 there have
4 been 11,407 incidents involving 5.1 product, 4
5 involve AM, 0 fatalities, so it gets back to what is
6 the problem we are trying to solve.

7 In a perfect world we would have zero
8 risk. But we don't live in a perfect world, we all
9 came here today and if you were anywhere near my car,
10 you are safe, there is a God, the way I drive.

11 Anyway in West Texas since that was raised, there was
12 a rail car on site, it did not propagate to the rail
13 car, it did not propagate to another bin that they
14 had in there so that should tell you something about
15 the threat, so to your question what are we doing
16 about safety, we are stern believers in training our
17 emergency responders.

18 We advocated for that strongly, we've gone
19 to the hill, we have gotten you permission to be more
20 flexible with your grant money, give more money to
21 training, we need to keep the training up. We have
22 ideas, since West Texas that your ERG needs to be

1 improved. We would love to work with whoever is
2 working on the ERG to try to help with that.

3 Do we think we need R&D on this? We do
4 not think we need R&D. Other things, if you didn't
5 have money, it is kind of a related thing and this
6 may be something that Jo would be interested in but
7 the UN is looking at revalidating all of the tests,
8 okay and we have talked a lot about the UN6 series,
9 UN8 series, their D test which is A&E's so those are
10 explosives are you know for the bulk A&E's and our
11 guys think that this test, I'll just read you, it
12 requires large sample and when a large sample fails,
13 that presents its own risks, right?

14 So in we think that the current test
15 doesn't match a typical accidental fire so we would
16 love to work with some people about improving that
17 test. Australia is also looking at this, you and
18 Australia partner up on that.

19 And I was you know, somewhere in the
20 stratosphere so I didn't quite hear what the
21 deliverable, I do have a question here, the
22 deliverable on this tire fire project was going to

1 be, I'd like to be able to know.

2 MR. FINK: Sure, let's talk about that.

3 Deliverables were strategies for consideration, in
4 order words open to any strategy. Energy
5 calculations around those strategies, Bill Fink from
6 PHMSA, strategies for consideration not just limited
7 to those that were presented. Energy calculations
8 around those strategies, additional costs to the
9 currently offered design, in other words with the
10 strategy comes an additional cost and that could be a
11 negative number too.

12 The risk frequency calculation, in other
13 words, what is the current risk for the general
14 population and then what would be the reduced risk
15 with the specific strategy and then if you stack
16 strategies how that might reduce this risk and then
17 the last thing was proof of concept via experimental
18 data.

19 MR. PAQUET: And Cynthia even if you
20 didn't get it, it will be posted.

21 MS. HILTON: Okay, just one question
22 generally, this is

1 MR. PAQUET: Hold on, wait please.

2 MS. HILTON: This is a proposal so is it
3 really too early, like I have no idea if you went
4 ahead with this, you know how much, do you have in
5 mind, if this would be a fourth of your budget, or a
6 tenth or anything like that? And can you tell us a
7 little bit, just generally on your project to
8 identify, how do you get to that point of giving them
9 a budget for any of these projects, how does that?

10 DR. LEBLANC: Well it certainly can
11 change. For example with the recent episode in
12 Canada with the real accident, thank you, sorry, it
13 certainly can change Cynthia so we have to be
14 responsive to things that we can't possibly predict
15 in terms of what accidents might come PHMSA's way and
16 we need to be nimble enough to react to that.

17 So it is, we try to do two things. We
18 need to of course be reactive, that is part of being
19 a regulator but we would also like to think that R&D
20 provides PHMSA with the ability to respond to future
21 risks and be proactive. Proactive is a funny word to
22 the stake holders mostly in this room right, because

1 it could sound like we are probably going to fine you
2 for things you don't know about yet and that is not
3 the case at all.

4 But it does speak to PHMSA's unique
5 mission in comparison to industry, right because our
6 stake holders are not just industry they are also the
7 American public and first responders. So all I can
8 say is we will put more and more effort into being
9 transparent with those decisions and to inform you as
10 soon as we can, but can I give you a time table as to
11 the decisions, probably not except to say that you
12 will be engaged, you will remain engaged.

13 So often times it becomes a situation
14 where you have got x amount of money and some
15 projects are cheaper, less expensive than others and
16 some will be shorter in duration and you just have to
17 be very strategic or select those projects when you
18 select them, if that makes any sense.

19 If you are hit with budgets in industry
20 you do the same thing do, I would imagine.

21 MS. HECKMAN: Julie Heckman, American
22 Pyrotechnics Association, I just really appreciate

1 the opportunity to be here today and hear where the
2 agency is going and am thankful that you are engaging
3 the stake holders. In follow up to the comment about
4 how you decide which projects will get money, which
5 ones are the highest priority, two that I really
6 didn't comment on this morning but I believe would be
7 really low priority for the agency concern the
8 novelties and the chained fused shells. While I
9 guess these move across the U.S. we haven't had an
10 incidents with them and the firework industry is so
11 small compared to the commodities out there.

12 However, those are two projects depending
13 on the extent of research you are looking for that I
14 think if you came to the APA and said hey Julie, we
15 really want to know how these chained fused shells
16 perform based on ones that aren't chained, will APA
17 do some tests. We could probably do that for you and
18 it is not going to be hundreds of thousands of
19 dollars of testing, but if you said and we would feel
20 a little bit better if we had some data or we had you
21 do this and you gave us some parameters and what you
22 were looking for.

1 Same thing with the novelties, I can't
2 offer that up on the waste issue because that is a
3 much more challenging project and we really have to
4 look at cutting the scope a little bit on that, but I
5 think not just my industry, I think with the gas
6 people, if you are asking about the odorant, which I
7 thought was really fascinating because I am sitting
8 here trying to figure out what does it have to do
9 with transportation, you know, what the odorant is,
10 but I think maybe if you tapped into the regulated
11 industry as much as you can on things that you need
12 and that might help save some of the dollars that you
13 are looking for or your limited funds.

14 MR. PAQUET: Come on guys, come on up.

15 MR. SANTIS: Thank you. I think that was
16 an opening, talking about proactive research because
17 I am going to throw out something in a proactive
18 sense, something you haven't talked about today an
19 idea that came about through APT research in Los
20 Angeles with APT research.

21 In preparation for this meeting we had
22 some of our scientists get together and conference

1 and brainstorm, one of the things that we thought was
2 important, what could PHMSA do in terms of the
3 research, especially in emerging areas and one of the
4 scientists, Eric Wilson brought up the idea of the
5 impact of increased use of liquefied natural gas, LNG
6 and not in the sense of the safety of that in and of
7 itself, I'm sure that's being taken care of and
8 looked out and is going to be safe, but the question
9 was how would the increase of that product on the
10 roads and perhaps even as fuel tanks on the trucks
11 that are carrying explosives, how would that effect
12 the performance of the explosives in an incident as
13 compared to a similar incident with the diesel
14 powered vehicle.

15 And so the question was, well does anybody
16 know? Nobody could come up with any research or any
17 testing that has ever been done with any compressed
18 gas in relation to how it might affect explosives.
19 And when you get right down to it, it would be, does
20 it make a division 1.3 explosive mass detonate
21 instead of not, does it make a 1.4 explosive mass
22 detonate instead of not. Does it make a division 1.5

1 explosive go more probably like a 1.1.

2 So it is just something that we threw out
3 there, maybe next year it is something to talk about
4 a little more in depth but I will throw it out there
5 and see if there are any comments, if anybody has any
6 ideas on that.

7 MR. PAQUET: Thank you.

8 MR. VOCKE: Bill Vocke from the, I am the
9 Executive Director of the Interagency Coordinating
10 Community on Oil Pollution Research and I want to
11 thank you for this very well done Forum. It is a
12 very good opportunity to discuss research and
13 development. What my question is, there has been a
14 dramatic increase in rail and truck transport with
15 crude oils, especially the Balkan crudes. Are you
16 considering any research into the relative risk
17 shipment by rail and truck?

18 DR. LEBLANC: The short answer is yes,
19 yes, yes. Short answer yes, it's probably consuming
20 so much of our time right now and absolutely an idea
21 if you wanted to call him.

22 DR. EL-SIBAIE: Yes, it's an emerging area

1 of course. I will be lying to you if I say we were
2 doing research now, we are behind the curve and we
3 are trying to catch up so research in support of
4 rule-making and other measures that we need to take,
5 but if I can just take a question and answer it
6 really broadly.

7 My hope and my plan and certainly what I
8 deem as necessary is not to limit the R&D, we have
9 heard a lot of technical things and they are
10 important and clearly the change there that we are
11 going to have to make is what Cynthia and others have
12 spoken of. We have to be more risk driven and we
13 have to be more collaborative with the industry by
14 the way, and certainly Julie and Cynthia we don't
15 want it to be that that is what you guys can do and
16 you already have done, or they have done already and
17 to the sense that we collaborate and go to the
18 experts and seek their input and of course figure out
19 a way to do this objectively and so that is what we
20 are going to do on the technical side.

21 But one thing that we haven't done or we
22 don't do in a planned fashion is this compactual

1 research piece. Understanding the commodity flow, we
2 have very little data, firsthand, very little data of
3 commodities or not as good of an understanding of the
4 data that we have as we should have so commodity
5 flow, how things are changing, what kinds of
6 additional risks you present to us are the, you know,
7 are the existing system of the right point, it may
8 have been what we were doing, how to chip it away
9 maybe things change, so yes I would hope that our
10 intent is to do more analysis to understanding how
11 things are changing and how this affects us.

12 MR. VOCKE: In our committee, PHMSA is a
13 member of the committee, you get representation from
14 the pipeline side but I am really interested in
15 coordinating with you, collaborating, we are just
16 trying to get some of the research done. We have
17 fifteen agencies on the committee side so there are a
18 lot of opportunities for work together on those
19 issues, thank you very much.

20 MR. STEVENSON: Boyd Stevenson, ATA.
21 First of all I want to echo a lot of the other
22 comments that I have heard today. I think in the

1 seven years that I have been with ATA I have been in
2 and out of the DOT buildings more times than I could
3 count and this has definitely been the meeting with
4 the most comedy and respect between people, both
5 government, industry and on all side. I really want
6 to hand it to you all, I am really you have done an
7 amazing job.

8 I also want to let you know we at ATA do a
9 lot of research on commodity flow and we would be
10 happy to sell that to you. We might have a
11 government discount.

12 AUDIENCE MEMBER: Can you give us a free
13 sample?

14 MR. STEVENSON: It self-destructs. But
15 I also want to say one area, and this is probably the
16 most boring kind of research to do out there is,
17 given some of our interactions that we have seen with
18 the 5800 recording and things there, I think it would
19 be very useful to do some analyses on the results of
20 some of the data that PHMSA is taking in and what it
21 is producing and how changes to what is indeed
22 collected and how it is being collected can yield

1 information that is more useful for driving the
2 future research.

3 Like I said that is the kind of study that
4 no one really wants to read but it is the kind that
5 is implemented and incredibly useful both for us in
6 industry and in government.

7 DR. WONG: I have a couple of comments.
8 I'm Kin Wong with PHMSA. One, since an explosive and
9 I just want to let you know and some of you already
10 know there is another form that the federal
11 government has called an Agency on Explosives. Its'
12 membership is limited to federal agencies but we do
13 welcome outside speakers so if you have ideas and the
14 advantage of the group is that we have pretty much
15 all of the federal agencies across the government,
16 from the State Department, to CIA to ATF to
17 everything, they are interested in explosives and
18 compounds and we also don't limit to any topic so
19 from rendering to law enforcement to policy to
20 technology and disposal all of those things, so if
21 you are interested you know to present ideas and
22 stuff, we don't have a research budget so we don't

1 do, but we can still get the ears of all agencies and
2 some of them you know have ideas.

3 The other thing is I want to talk about
4 commodity someone told me some of the compounds,
5 interested materials, I guess I should say, sometimes
6 we say compounds but the interest and sometimes we
7 handle with confidentiality and secrecy. For example
8 an idea that is actually a complete commodity full
9 analysis however is classified and it is in the
10 possession of the Coast Guard so you know, unless you
11 have security cameras and certain things that you can
12 get to.

13 And the other thing that we are calling
14 for is I encounter again with AN and I'm not trying
15 to pick on AN, and what happens is it has many names,
16 you know, you can collecting data from rail to
17 waterway it goes by, see when I was at EPA we used
18 cast iron, you know, because we want a specific
19 chemical, you know, with a very specific quality and
20 all this different molds and it's hard to compile
21 data so that's all.

22 MR. PAQUET: All right.

1 MR. BORNHORST: Good afternoon everybody,
2 I am Richard Bornhorst with the FDA. I would just
3 like to say that I am supportive of the direction
4 that you are going in with your program. The more
5 research you can do the better, I definitely believe
6 that research should drive regulation. Analysis
7 should drive regulation and not the international
8 community and I see that all the time. They come up
9 with these one page papers with no explanation as to
10 why something needs to be changed and I think they
11 need to start doing their homework because we are
12 trying to do our homework and it is only fair.

13 Also in addition to me working at the IAN,
14 I am the chairman of the Hazardous Materials
15 Transportation Committee at TRD and this week is the
16 TRD meeting and we have over 11,000 participants. It
17 is a great venue to discuss research, there is a lot
18 of academia there and one of the things that keep on
19 occurring throughout the week is I kept on being
20 approached by not Hazmat professionals, freight
21 professionals, transport professionals and they all
22 had a lot of questions about crude oil and rail and

1 that is justifiable so because of the accident but
2 there is also a lot of questions about LNG and rail,
3 LNG and domestic waterways and growth of the chemical
4 industry.

5 On Tuesday we actually by chance, we did
6 have a really good session on the growth of the
7 chemical industry and how that affects emergency
8 responsibility and one of the things that I would
9 like to suggest is as you move forward and do this
10 research, I think that once you start having results,
11 it's not about just putting a report together and
12 pursuing regulatory change, it's about getting the
13 word out there about the great things that we are
14 doing and if you can encourage people to submit
15 papers to tier B and give their peer review in the
16 broader research community, I think that it will
17 bring a higher level of visibility to Hazmat because
18 I know for a fact that there is a lot of transport
19 people out there that are eager to see some of these
20 issues resolved.

21 They just don't know enough about Hazmat,
22 we know that. Let's get plugged into these groups

1 and I can't stress enough the importance of not
2 letting stuff sit on the shelf. I have seen a lot of
3 good research done and you know people leave or
4 retire and nothing happens and again if there is a
5 way for them to set up a national plan of where we
6 want to go with this and stick to the plan I would be
7 supportive of that as well, thank you for this
8 meeting and thank you for the opportunity to comment.

9 MR. PAQUET: Thank you Rick, I appreciate
10 it.

11 MR. SCHICK: Hi, I'm Tom Schick I'm with
12 American Chemistry Council. I just want to second
13 Boyd's motion about the sharing the openness here,
14 the entire staff and a special mention to our
15 facilitator.

16 (APPLAUSE)

17 MR. SCHICK: I just want to let you know
18 that we have the review of our five year data and it
19 is on our website so please do check it out and if
20 you have any comments or any ways that we could
21 improve it next time, please fill it out.

22 MS. HILTON: To your comment about

1 commodity flow and Boyd's and yours about five year
2 data and then you answered it, but you know one of
3 the things that industry collectively has urged you
4 to do is you know your hazmat transportation,
5 whatever you want to call it, the OTA which no longer
6 exists, you know, with a big report in '86 that we
7 all quoted from and then you all tried to update it
8 in '98 and we still refer to that '98 stuff so I
9 don't know if that is a research project or what it
10 is but you know everybody needs a denominator because
11 we think you have, I've told you this before, a huge
12 success story.

13 You are so successful given what happens
14 and you should tell it more.

15 MR. PAQUET: Thank you Cynthia. All right
16 last call, I am going to start flicking the lights
17 off and on. Listen I really appreciate all of you
18 playing by my rules today, I was a little bit of the
19 taskmaster and it was only one person that went over
20 but it was worth it because it was interactive so I
21 appreciate you participating, you coming here, this
22 is our first one, please provide us with comments on

1 how we can do next year better.

2 Should it be two days, should it be you
3 know one day of industry research? We want to know
4 that information, that's just, so please provide us,
5 this is going to be annual, this is the first annual,
6 which means guess what, there has to be another one
7 next year and so I am going to allow Dr. El-Sibaie to
8 give our closing comments and then we can all escort
9 you out.

10 DR. EL-SIBAIE: I'm not going to keep you,
11 thank you so much for coming. I told you this
12 morning I did not expect this crowd so that's a good
13 surprise. It means that you care about what we do
14 and transparency I think is what we are beginning
15 with, transparency leads to correcting behavior so we
16 want to put out stuff out there, we want to hear from
17 you and we want to impress upon you the need to make
18 your case objectively and provide us the basis for
19 why you object or if you want us to change direction
20 what is the reason by which you want us to change
21 direction.

22 Because you know we, in spite of our worst

1 behavior we tend to be on the rational side most of
2 the time so we would like to have a reason as to why
3 you want us to do things differently and it has to be
4 related back to the public on the goals, these are
5 the only goals that we have here at PHMSA and the
6 DOT.

7 Of course second is our goal, we don't
8 want to shut down anyone or impact, impact in the
9 industry or impact towards humans. Really it's about
10 the conscience you want to make sure at the end of
11 the day everybody is winning. Industry is winning
12 and certainly the public which we are paid to protect
13 is also winning, so that's our goal.

14 I set goals for this morning, this is a
15 modest program. I gave you what our budget is, it's
16 not an excuse for us, but certainly it is the
17 beginning. I hate that it is modest for the task I
18 think the amount of funding is not adequate given the
19 broad issue of questions and challenges that we have
20 and we also are recognized, I recognize that our goal
21 or intent is not to duplicate it or complicate any
22 R&D effort that has to be run by the industry, the

1 bulk of the R&D and for good reason.

2 Ours is different and ours should be
3 targeted on safety challenges and the safety
4 questions that we need to have a mission with. If
5 there will be a point of perception is that the
6 industry is looking at the same issues that we are
7 interested in and it helps indicate our, and give the
8 industry what it needs to be, that's where we are
9 going to collaborate but we really respect your
10 feedback and we really value your feedback and if you
11 provide it to us often and you provide us with the
12 context national, oh my gosh, we could really use it.

13 So thank you so much, again thank you for
14 indulging us today and thanks for my staff, you did a
15 great job. Everybody did a great job and we are
16 really appreciative for you.

17 MR. PAQUET: All right so we started the
18 day with someone that wouldn't interrupt and we are
19 going to end the day with somebody who won't
20 interrupt either.

21 MR. SCHICK: Thanks and I appreciate that,
22 just let me say a few quick words. As I said, and as

1 Cynthia has said this morning, this program, this R&D
2 effort is hugely important to us because it is going
3 to obviously help all of you we hope and has Magdy
4 said the public that we are all here to protect but I
5 also want to give a shout out to Magdy and his team
6 because we have talked about R&D and hazmat and this
7 is just a, I give him a lot of credit for making this
8 happen because it has been a long time coming.

9 It has been needed we have a very
10 ambitious R&D program on our pipeline side, but it is
11 something that we needed here and Magdy and Carole
12 and everybody, you have a great team here and so I am
13 looking forward to great results and your
14 participation is going to make it work so you have
15 our attention.

16 MR. PAQUET: Thank you Tim. That's it

17 (APPLAUSE)

18 Whereupon at 3:02 p.m., the research and
19 development forum meeting adjourned.

20

21

22

A				
A&E's 202:9,10	achieved 51:3 180:9	Advisory 82:7	allergic 39:12	angle 46:14
a.m 1:12	acknowledge 135:11	advocate 123:14	Alliance 80:10	announcement 4:17
Abdelkader 3:13	acoustic 63:2 67:12	advocated 201:18	83:19	89:15
162:22,22	act 143:10 195:3,6	advocating 124:4	allocate 16:10	annual 9:9 219:5,5
abilities 16:7	198:21 199:9	aerial 14:15	allocation 15:8	anonymous 20:17
ability 34:18 37:1	acting 82:6 148:10	aerosols 111:22	allotted 7:12	answer 11:15 25:19
39:20 58:4 67:4	action 107:21	affect 65:9 73:17	allow 21:7,21 23:21	56:17 63:22 67:22
79:11 103:3	actions 57:16 165:7	153:16 208:18	50:10 92:18 97:3	68:13 77:12 81:9
176:16 204:20	activate 93:7 145:7	affiliated 139:14	219:7	110:18 126:21
able 28:22 40:3	activated 143:7	affiliation 24:2	allowed 97:12	127:5 164:8 195:9
41:4 51:9 67:5	active 79:1 81:2	afflictions 70:15	102:6 177:21	195:9 209:18,19
88:8 91:12 92:7	111:14	aftermath 147:12	allows 73:14	210:5
101:6 119:1,9	activities 91:5	afternoon 27:11	alternate 72:17	answered 218:2
138:17 203:1	activity 90:13 92:3	35:16 141:22	193:6	answers 92:22
absolute 182:10	92:8,12,21	155:2 167:10	alternative 83:11	anybody 27:4 66:19
absolutely 66:2	actual 40:22	181:19 215:1	alternatives 83:12	92:7 98:16 139:14
128:2 156:19	add 23:6 42:1	agencies 54:22	199:8	165:5 208:15
159:3,4 164:4	adding 124:7	78:22 86:7 87:16	aluminum 60:9,12	209:5
209:20	addition 53:8 75:9	211:17 213:12,15	60:20 157:20,21	anymore 157:20
academia 215:18	186:15 215:13	214:1	amazing 212:7	167:5
acceleration 172:18	additional 53:2	agency 8:13 10:12	ambitions 13:8	anyway 54:5 58:14
176:4,6	67:9 68:8 77:16	13:15 81:9 192:3	ambitious 222:10	159:19 199:19
accent 84:13,14	88:7 112:14 115:8	206:2,7 213:11	Amco 159:18	201:11
acceptable 11:20	159:1 184:3 203:8	agenda 6:18 7:5	America 80:10	anyways 27:11
128:7	203:10 211:6	16:2 26:9 54:1	American 19:13	APA 125:20 128:8
accepted 187:13	additionally 63:22	164:9	96:8 161:7 184:9	129:21 130:22
access 84:17 85:3,7	additions 70:1	agent 29:19 98:18	205:7,21 217:12	206:14,16
88:21 192:9	additive 184:3	122:8	Americase 180:14	apart 110:7 139:12
197:10	address 12:5 37:6	aggressive 181:8	ammonia 45:9 48:9	apologize 37:18
accident 14:8	126:9 128:10	aging 62:20	ammonium 155:3,4	192:13 199:18,19
136:21 148:22	129:13 141:13	ago 54:9 56:7 79:7	156:2,2,4 160:13	apparatus 40:15
166:1 204:12	addressed 90:10	129:22,22 140:12	160:14 164:15	59:6 172:15
216:1	121:7 132:18	170:6,11 188:8	200:6	apparently 150:5
accidental 202:15	addressing 191:15	agree 40:1 81:1,21	Ammunition 38:5	appeared 120:10
accidents 17:4	adequate 74:11	117:14 165:19	Ammunitions 111:1	appears 182:18
146:2 149:1 165:2	75:15 220:18	179:11 185:9,15	amount 12:19	196:5
170:3 204:15	adequately 102:19	189:5 193:7	14:20 41:7 116:4	applaud 78:5 138:1
accommodated	adjoin 46:17	agreed 117:8	126:3 135:15	APPLAUSE 217:16
180:2	adjourned 222:19	198:22	148:16 156:12	222:17
accomplish 124:22	adjustments 198:9	agreement 85:12	160:19 205:14	applicable 64:11
158:6	admin 19:3	167:14	220:18	67:17
accomplishments	administering	Agricultural 48:19	amounts 153:18	applicants 93:20
20:5 84:22	96:21	ahead 21:4,13,20	analyses 212:19	application 68:6,7
account 86:4	Administration	22:14 23:15 51:22	analysis 15:19,21	68:11,14 98:11
121:19	85:17 194:16	52:7 60:1 204:4	15:21 46:7 90:18	125:22 126:1
accurate 183:15	administrative	aide 91:12	92:9 139:18	applications 98:5
accurately 37:20	99:14 141:8	air 41:5 59:7 72:21	170:13 171:12	168:8,10,11
118:21	administrator 3:19	73:4 138:17 199:9	176:22 178:2	171:14,16,22
accused 189:22	8:20 193:22	aircraft 130:16	179:21 180:6	applied 61:7,11
acetylene 149:5,8	194:17	168:17 170:3,3,4	211:10 214:9	62:13,16,18 76:17
152:10 175:12	admire 196:22	170:8 171:18	215:6	applies 74:6 150:6
achieve 30:13 31:18	admissible 11:20	176:14	analyst 163:11	apply 29:18 63:12
41:2,6 59:13	ado 20:8 28:8	Alamos 46:3	analytical 74:21	67:15 117:4
111:20 112:3	advantage 213:14	alarm 4:14,16	and/or 190:12	appreciate 9:6 18:8
181:10	advisor 19:22	alignment 83:6	anecdotally 187:8	19:6 59:1 82:8,22
		alive 100:8	Angeles 207:20	98:22 109:2

150:12 152:19 163:2 181:14 205:22 217:9 218:17,21 221:21 appreciated 28:7 appreciative 221:16 approach 15:6 107:1 127:13,17 188:13 approachable 110:1 approached 124:19 215:20 approaches 125:3 approaching 110:9 appropriate 17:7 27:2 134:5 appropriation 24:13 approval 91:4 126:1 138:11 180:19 approvals 4:6 27:5 73:7 100:5 130:3 133:1,17 155:1 169:14 171:6,9 177:11,13,14 approved 138:15 approving 127:19 approximately 30:7 31:19 52:12 173:22 April 89:6 160:16 APT 207:19,20 area 5:5 29:18 46:4 47:6 49:15 65:8,8 65:8 91:21 125:13 125:16 147:20 178:6 183:16 209:22 212:15 areas 95:12 101:7 132:10 151:7 152:5 161:12 178:6 183:11 208:3 arena 157:7 arguing 79:8 arm 140:1 arms 38:5 111:1 187:17 array 133:11 articles 103:18 105:10 107:9,11 articulated 56:6 artist 47:21 189:14 Asian 19:12	asked 12:18 66:6 77:10 90:13 asking 56:7 200:15 207:6 asleep 167:4,5 ASME 44:12 aspect 26:15 43:9 44:14 48:11 51:8 51:10 94:16 149:13 183:1 184:2 aspects 48:15 57:22 75:21 162:6 assembly 29:5 32:15 39:18 assess 59:14 92:15 137:14,20 assessed 38:18 68:9 assessing 62:4 67:8 67:9 123:10 assessment 67:5,19 assessments 101:18 assign 106:11 associate 8:19 29:15 associated 86:12 87:1 88:18 92:4 92:16 107:19 170:2 178:19 association 48:19 63:18 65:11 67:2 76:14 97:20 111:13 128:22 137:6 150:17 153:13 161:8 166:16 185:8 188:22 189:2 190:17 191:8 193:18 205:22 associations 87:16 96:9 assume 195:20 assumed 151:4 assuming 98:11 assure 126:11 127:21 ASTN 79:18 ATA 211:20 212:1 212:8 ATF 213:16 atrium 140:9 attached 133:9 attain 176:7 attempting 128:10 attempts 51:2 attendance 88:1	attention 13:16 15:9 222:15 audience 9:14 13:2 13:3 18:15 23:18 26:7 128:15 212:12 August 43:19 Australia 157:3 202:17,18 authorities 86:8 136:4 authority 98:8 authority's 42:5 authorized 36:21 37:6,14 authorizes 72:19 auto 123:5 automated 85:4 automation 83:13 automotive 168:6 171:15 available 6:15 33:4 39:16 50:22 65:16 65:21 73:6 88:21 131:18 188:16 Avenue 1:7 average 46:8 115:15 avoid 148:17 award 160:3 198:18 198:19 aware 4:21 51:13 71:21 80:11 179:13 190:22 axles 158:15,17,17	179:1 181:19 183:13 188:20,21 189:1,2 190:19 200:21 201:5 220:4 background 69:13 83:22 84:18,19 115:18 118:16 bad 5:20 148:6 154:13 158:13 166:5 200:6 badge 5:11,13,17 badges 5:9,10 Balkan 209:15 bang 150:11,11 155:19 159:2 barbeque 185:22 barge 200:18 Barrett 2:10 25:11 38:4,5 82:5,5 110:22,22 119:13 119:13 base 8:6 40:2 46:14 53:10 69:16 86:3 109:6 based 15:6,10 16:11 32:4 42:4 45:17 67:13 75:5 97:2,4 101:2 109:13 115:15 160:2 206:16 baseline 118:2,19 basic 10:8 143:3 basically 35:4 37:13 45:18 58:20 59:19 61:17,22 62:9,15 62:21 64:2 73:15 78:4 89:9 126:6 130:4,17 132:16 132:19 140:8 163:11 173:4,13 191:4 basis 128:11 171:7 180:3 219:18 bath 30:21 32:11 batteries 167:13,18 167:21 168:6,9,11 168:15,16,17,19 169:8,9,10 170:2 170:5,7,14,14,16 170:17,19,21 171:1,13,15,17 172:20,20 177:1 177:10,11 178:2 178:22 180:18 battery 168:5,21	169:19,20 170:15 171:20,21 173:1,2 173:11,14,21 174:1,1,6,14 175:3,7,10,11,14 175:18 176:3,18 178:16,18 180:7,8 181:6 beam 46:14 beat 28:10 beautiful 14:11,12 beauty 168:21 becoming 142:12 148:10 began 43:19 beginning 21:10 185:1 201:1 219:14 220:17 begin 15:5 behavior 52:19 123:7,9,17 219:15 220:1 behold 79:16 behooves 187:3 beings 25:8 believe 6:4 9:4,5 11:16 12:6 13:11 13:12 30:1 57:17 57:19 111:3 113:5 127:16 131:13 154:11 167:1 206:6 215:5 believers 201:16 Belly's 140:17 Ben 2:10 39:15 69:4 69:5,8 82:5,7 84:5 110:22 119:13 beneficial 40:8 benefit 87:11 161:14 benefits 33:1,15 34:2 40:5 42:11 86:13 92:16 BENJAMIN 2:20 Berger 79:8 best 14:4 18:15 21:14 71:22 72:7 72:11 91:12 107:6 111:6 127:17 135:10 158:14 166:2,11 187:9 199:19 better 11:14,15 15:22 21:12 25:19 34:6 72:17,22 73:8 76:8 77:18
---	---	--	---	---

B

86:2 93:16 123:1 124:11,11 139:11 144:3,3 183:21 188:13 206:20 215:5 219:1 beyond 63:11 76:18 77:2 112:12 148:20 bias 13:2 bid 25:4 75:1 big 10:13 32:19 142:12 146:13 162:20 164:15 168:1,4 174:1,20 182:8,13 191:21 218:6 bigger 29:21 42:10 164:17 175:2,2 Bill 3:16 38:5 98:7 154:21 155:1 203:5 209:8 Bill's 154:21 billion 187:10 Billions 200:10 bin 201:13 bio 20:2 bit 13:4 29:15,17 30:2 32:18 34:6 34:11 40:11 52:1 90:7 94:8 114:5 114:19 115:5 149:9,10 167:19 175:3 190:15 204:7 206:20 207:4 218:18 blah 162:9,9,9 BLEVE 153:21 154:1,9 blindsided 98:17 blowing 191:5 blunt 179:9 board 50:9 63:3 64:3 68:15 108:1 122:9 134:21 136:20 137:8 153:3 162:4 Bob 2:7 78:3 93:2 199:19 body 81:5 bomb 137:19 bonfire 28:13,18 36:2,13 104:3 113:12 114:2,19 116:14 124:1 book 105:17,21 117:9 119:6	121:15 borderline 40:12 boring 212:16 Bornhorst 3:17 215:1,2 Boston 84:13 bottle 189:8 bottles 65:14,18 bottom 142:19 boundaries 39:14 box 20:13 21:15,16 72:5,5 79:7,13 126:17,17,22 127:1,2,3 box-shaped 72:5 boxes 79:9,11 129:3 Boyd 3:3 96:8 161:7 211:20 Boyd's 217:13 218:1 brainer 93:17 brainstorm 208:1 branch 27:21 43:4 100:10,16 101:4 141:21 brand 61:7,8,19 62:10 brave 159:8 break 47:6 51:22 55:2 99:10,12 138:7,10 181:16 192:17 193:21 194:1,1,2 breaks 115:14 breathing 59:6 Brian 3:5 100:16,18 109:1 111:6 113:4 113:19 119:11,19 120:6 124:17 197:15 bridges 147:19 brief 35:15 84:15 84:18 92:20 101:1 102:2 108:20 111:2 briefing 4:11 briefly 9:4 10:9 60:4 102:22 bring 24:6 48:16 138:4 173:1 174:21 216:17 bringing 95:22 broad 114:3 119:16 121:21 169:7 220:19 broadband 98:4	broader 42:10 120:9,11 216:16 broadly 210:6 broken 133:9 brought 38:16 62:1 132:12 208:4 Brussels 179:15 buck 150:11 159:3 budget 9:11 10:12 120:16 191:4 204:5,9 213:22 220:15 budgets 197:9 205:19 build 15:6 builders 43:11 building 4:13,19,21 5:1,12 20:6 140:6 140:7,11,19 141:1 146:19 147:18 buildings 212:2 bulk 11:1 14:2 155:13 186:17 202:10 221:1 bullet 114:6 bullets 106:13 bump 19:5 bunch 140:15 bunker 134:6,19 bunkers 135:16 Burlington 188:18 burn 41:6 115:22 116:3,11 118:4,15 124:7 169:4 175:14 burned 79:5 burner 114:21 burners 37:3 burning 32:15 34:3 34:10 40:22 103:3 113:3 156:20 162:9 burns 116:5 burst 61:2,15,20 63:7 143:12 144:16 bursts 143:11 business 113:2 busy 22:17 147:14 Butters 3:19 191:11	CA's 177:10 cafeteria 140:7,10 cakes 129:7,10 calculate 119:9 calculated 45:17 calculation 116:8 116:16 117:1,4,6 118:5,13 203:12 calculations 158:7 158:22 203:5,7 Caldarera 3:10 150:16,16 151:2 185:7,7 186:10 calibration 118:2 California 136:5 call 8:9 136:5 158:14 179:22 188:7 209:21 218:5,16 called 59:7 60:13 62:18 98:6 146:18 151:9 169:4 172:8 172:17,22 173:4,6 173:10 177:5 179:13,22 180:14 213:11 calling 36:10 214:13 camera 31:17,18 cameras 118:8 214:11 Canada 14:8 18:16 157:3 204:12 candidates 76:17 131:7 candidly 191:4 candlestick 154:3 candlesticks 147:9 canister 185:21,22 cap 144:8 capabilities 87:17 91:11 99:3 capacity 82:6 capture 24:3 car 193:16 201:9,12 201:13 carbon 30:9 60:8 60:11,21 66:10 care 208:7 219:13 careful 15:15 121:8 cargo 48:2 52:7,10 52:13 56:4,13,20 57:4,18 58:1 66:15 85:4 156:14 158:13,18 163:19 Carl 140:12	Carole 2:4 18:11,12 28:1 36:17 195:13 222:11 Carolina 189:7 carrier 98:17 carriers 10:18 47:22 86:10 87:19 88:20 94:14 95:3 95:17,22 carry 156:12 carry-over 118:17 carrying 35:10 208:11 cars 185:9,13,17,20 186:11,12 190:1,3 190:12 cartridge 103:19 case 19:1 23:12,12 116:11 154:13 171:7,7,11 175:20 178:1 205:3 219:18 cases 11:21 40:12 81:15 133:13 175:15 cast 214:18 casualties 142:12 catastrophic 143:10 catch 210:3 category 107:12 caught 146:8 cause 26:3 43:20 44:17,22 45:14 74:16,20 75:2 145:8,9 150:18 177:2 182:10 causes 44:16,18 74:22 144:21 145:19 168:22 182:11 189:17 CBSC 136:9 CD1 144:12 CD2 144:17,21 CD3 144:18,22 145:4 CD4 145:4 CD5 145:4 CDA 143:18 cell 6:9 99:17 center 14:13 56:10 85:13,15 167:15 172:2,14 175:17 centigrade 62:2 104:9 central 146:3 century 99:20
C				
c 29:6 31:20 41:20 190:21 c's 54:3,5 C6-2 68:11				

certain 43:21,21 82:17 103:18 104:22 118:20 128:2 173:11 176:7 214:11	219:19,20 changed 70:3 92:18 101:19,20 102:12 109:17 183:17 188:2 190:10,20 215:10	city 162:18 200:4,4 CL 2:21 76:13 clarifications 53:17 clarify 7:18 136:1 136:21	50:8 58:18 83:21 collaborative 81:22 210:13	26:7,9,11 50:20 66:9 80:5 82:15 89:12 91:2 108:15 119:21 120:19 122:6,15 141:10 152:19 153:1 163:1,5 164:19 165:17 166:19 179:8 190:15 192:10 195:5,7,17 195:18 206:3,6 217:8,22
certainly 12:1,20 13:6 27:3 81:14 110:17 112:14 127:12 129:9 138:11 151:17,19 153:14,19 163:20 187:3 194:14 204:10,13 210:7 210:14 220:12,16	changes 40:10 69:22 76:8 90:6 212:21	class 9:21 116:3 126:4	colleagues 18:17,18 191:8	179:8 190:15 192:10 195:5,7,17 195:18 206:3,6 217:8,22
certified 50:16	changing 17:22 211:5,11	classification 39:19 55:21 103:6 116:3 116:7 128:3,6 129:15 139:4	collect 90:17 92:4	comments 6:16,20 7:3,4,6,9,10,14,14 20:17,21 21:1,2,7 21:15 23:14,21 24:1 25:2,6,7,9 26:13 27:3,7,8,10 27:11,14 28:7 34:22 35:14,15 42:16 53:17 78:16 81:1 82:9,13 89:16 90:2,3,11 100:7,21 101:6 102:1 106:17 108:18,18,20,21 111:2 113:15,17 121:1 123:20 135:22 150:14 153:11 161:9 163:20 165:14 179:5 191:2,22 193:5 194:13 195:3,11 200:2 209:5 211:22 213:7 217:20 218:22 219:8
cetera 101:16 113:3 168:12,17 169:5 171:17 172:15 174:4 176:19 178:3,16 183:19	characteristics 131:3	classified 39:12 214:9	collected 132:12 135:17 212:22,22	collecting 53:12 89:4 214:16
CG 68:11	characterized 95:21 96:2	classify 54:2,4 131:5	collective 88:13	collection 89:13 90:13 91:5 92:3,8 92:12 124:11 151:16
CG7 145:14,16	charge 176:18	classifying 123:4	collectively 218:3	color 39:11
chain 126:20 128:9 128:14,17 142:10 148:11	charges 103:19	clean 29:10 32:15 199:9	combination 70:14 145:3	combinations 72:4
chained 125:15,17 126:6,9,12,17,18 128:5 135:21 206:8,15,16	Charles 196:9	cleaned 187:1	combined 11:5,21	combustibles 158:12
chains 127:3,4,8,19 127:21 128:7 129:10,11,12,14	Charleston 189:7	cleaner 34:3,9	combustion 37:17	come 5:15,16 7:9 17:11 18:6,7 25:16 35:5 44:10 66:12 77:15,20 82:3 106:14 114:15 117:16 121:5,12 133:7 138:13 139:6 140:9 145:20 159:19 160:17 183:21 204:15 207:14,14 208:16 215:8
chair 1:13 2:2	chart 24:13	clear 16:22 154:6	combustion 37:17	comes 20:2 107:14 110:2 116:13 117:7 120:22 121:14 136:7 138:8 154:1 203:10
chairman 82:6 98:8 215:14	chasse 46:17	clearer 34:11	comedy 212:4	commercial 46:16
challenge 17:2,14 135:18 167:22 168:19	cheap 148:6 158:1 188:16	clearly 17:4 109:18 186:21 210:10	comes 20:2 107:14 110:2 116:13 117:7 120:22 121:14 136:7 138:8 154:1 203:10	commercially 33:4 39:16
challenges 10:19 12:7,13,14 14:21 15:3 220:19 221:3	cheaper 73:1 205:15	click 22:5,18 100:6	comf 212:4	Commission 191:3
challenging 207:3	check 20:20 188:13 217:19	client 79:16	comfortable 135:5	committed 24:16
chamber 175:20,21	chem 20:2	clients 79:5	coming 4:5 8:10,12 9:1 20:10 28:2 69:5 96:11 100:12 109:18 139:3 141:15 197:21 218:21 219:11 222:8	committee 25:17 37:10 137:7 211:12,13,17 215:15
champions 21:19 22:14,21	chemical 20:3 134:21 136:20	climate 174:2	common 6:21 18:10 24:4,19	commodities 55:17 206:11 211:3
chance 22:10 144:3 156:21 186:2 216:5	chemicals 169:3 188:6	clock 52:8 61:14 64:21 96:17 110:10 147:13,16 147:22 162:10 166:19 167:1		commodity 14:19 130:17 153:17 163:8 211:1,4 212:9 214:4,8 218:1
change 23:4,13 42:3 69:19 110:19 112:12 167:12 174:10,11 176:5,8 204:11,13 210:10 211:9 216:12	chemistries 182:3,4 183:18	close 4:16 24:7 61:14 64:21 96:17 110:10 147:13,16 147:22 162:10 166:19 167:1		common 79:15
	chemistry 180:8 186:5,6 189:14 217:12	closed 91:2,2 99:15		
	chicken 140:16	closely 107:19 172:12		
	chief 19:18 27:21 191:11 197:15	closer 67:22 148:18		
	Chief's 166:17	closest 5:15		
	Chiefs 65:12 97:20 111:13 128:22 153:13 193:19	closing 219:8		
	chill 143:2	clothes 112:15		
	Chinese 96:9	CNB 111:11		
	chip 211:8	co-ops 49:15,18		
	chronologically 18:18	Coast 214:10		
	CIA 213:16	codes 153:16 178:2 187:12		
	circuit 169:2,3	coffee 6:3,5,7 52:3		
	circuited 177:6	collaborate 80:17 210:17 221:9		
		collaborating 211:15		
		collaboration 43:5		

127:10 130:8 171:3 173:9 187:19 commonly 33:3 59:6 60:5,12,21 64:5 communicate 39:20 54:2,4 97:6,8 communicated 97:13 communicating 86:14 communication 84:9,16 86:1 96:18 99:5 195:2 communications 85:4,6,19 88:14 93:13 97:22 communities 89:21 community 86:7,9 98:13 147:21 166:15 209:10 215:8 216:16 compactual 210:22 companies 180:1,3 company 93:3 95:15,20 179:21 180:14 188:6,8 compare 73:8 compared 206:11 208:13 comparison 107:4 205:5 compatibility 153:17 competent 42:5 competition 93:1 competitors 180:17 compile 214:20 complete 11:3 14:16 15:22 16:6 29:14 45:19 214:8 completed 30:9 38:1 67:3 85:1 87:6 89:1 92:11 92:12 completely 11:16 11:17 12:4 14:10 14:13 16:14 40:1 147:18 completion 63:8 compliance 132:12 169:16 complicate 220:21 complicated 134:10 compliment 191:9	192:2 compliments 122:14 190:16 192:4 comply 125:21 136:15 component 82:17 200:13 components 138:15 177:3,4 179:4 198:21 compose 198:20 composite 59:11 60:4,6,7,11,14 61:19 67:4 72:1 composition 129:11 129:14 compounds 213:18 214:4,6 comprehensibly 68:13 compressed 67:1 73:4 208:17 computer 43:18 175:22 176:2,11 conceived 85:8 concentrate 21:18 152:4 concentration 188:12 concept 32:20 33:14 159:3 161:13 203:17 concern 156:8 179:20 181:22 184:16 185:3 186:1 206:7 concerned 38:14,20 38:21 51:4 64:10 82:21 83:1 111:14 166:21,22 168:15 concerning 169:19 170:20,22 concerns 26:3 86:5 88:14,17 90:6 161:10 169:13,15 170:1 conclude 7:17 concludes 47:17 conclusion 63:8,10 153:6 conclusions 33:19 39:10,18 conclusive 151:21 Concurrent 92:2 condition 184:19	conditioning 70:11 70:19 conditions 10:16 13:13 44:5 53:13 53:13 56:11 64:22 133:8 conductive 81:10 conduct 32:3 91:17 conducted 35:4 43:13 91:18,21 conducting 28:14 78:14 81:12,12 94:18 95:7 180:6 conference 207:22 confess 8:22 confidentiality 214:7 configuration 62:22 63:12 67:8 configurations 126:13 127:6 confined 39:2 105:10 106:3 185:13 confirm 183:7 confirmation 147:5 confiscate 136:7,11 confiscation 136:3 137:13,17 confused 36:7 139:19 congestion 93:15 congratulations 24:13 Congress 87:4 congressional 93:18 conjunction 11:2 Conley 2:13 47:20 47:21 48:17 54:7 54:7,21 66:8,8 connected 98:2 Connors 194:17 conscience 220:10 consequence 165:3 165:4,11 197:19 consequences 146:16 conservative 109:12 conservatives 137:12 consider 8:12 42:12 106:5 123:15 129:3 131:12 164:10 197:15 consideration	158:21 183:3 203:3,6 considered 41:8,12 42:7,9 46:20 130:21 131:2 considering 108:11 152:2 209:16 consistency 125:4 consistent 48:9 117:19 177:12 constant 29:6 31:18 31:19 34:14 constructive 165:14 165:16 194:13 195:2,7,10,17,18 consultants 94:15 consultation 86:20 87:5 89:2 consulted 87:7 consume 30:18 181:5 200:9 consumed 31:22 consumer 132:20 186:17 191:2 consumers 182:14 consumes 159:10 consuming 209:19 consumption 32:4 34:18 contact 100:10 197:16 contain 37:11 54:2 54:4 126:3 127:1 127:2 146:18 175:20 180:17 contained 149:17 160:14 containing 33:5 155:3,4 containment 185:18 contamination 44:20 content 59:3 contents 70:21 98:6 144:15,21 145:16 145:19 context 163:4 200:6 221:12 continue 5:4 13:20 14:18 34:8 36:19 65:15 73:21 81:2 167:17 CONTINUED 3:1 continuous 155:12 182:19	continuously 155:9 contract 137:2 178:9,11 contractor 136:22 contractors 55:5 contrast 8:8 163:4 contributable 57:15 contribute 57:9 65:18 79:11 contributor 52:15 control 41:6 56:8 56:17 convened 1:12 convenience 128:20 128:20 conversation 41:13 80:6 98:1 163:16 194:14 convinced 165:7 cool 29:10,15 32:5,9 34:19 cooling 156:6 cooperation 50:6 Cooperative 25:13 Coordinate 65:14 coordinating 209:9 211:15 copies 66:5 corner 52:3 70:13 72:4,6,7,11,13 147:3 194:20,21 corners 72:4 coroner 54:18 correct 51:12 68:17 109:14 121:10 160:22 correcting 219:15 correction 115:20 corrections 118:3 corrosion 43:16 44:4 45:15 47:5 cost 30:1 34:17 124:8 134:9 140:1 203:10 Costa 179:13 costs 69:19 86:13 92:16 159:1 161:15,18 203:8 Council 19:13 82:7 217:12 count 148:13 212:3 counted 148:14 countries 38:12 country 70:7 71:6 149:4 couple 4:15 13:21
---	---	--	---	---

19:7 36:5 44:15 56:7 72:1 99:13 122:11 139:10 141:7 156:1,20 158:3 168:7,8 185:12 198:16 213:7 couples 31:7 33:10 course 20:13 65:3 101:14 115:4 129:10 130:19 131:15 134:9 167:17 168:7,16 169:9 171:2,14,16 173:12 176:22 177:4 199:10 204:18 210:1,18 220:7 court 6:12,13 covert 161:22 cover 20:22 21:9,17 97:14 122:1 125:12 covered 30:8 Covino 2:8 26:10 26:12 55:9,10 107:22,22 162:3,3 crack 43:17 44:13 51:5,5 138:2 cracked 152:13 cracking 43:17 44:4 45:13,14 47:5,8 cracks 46:11 craft 16:10 crash 54:14 crashes 52:12 crazy 80:2 create 29:20 41:5 45:10 75:2 100:2 164:9 created 22:5,13 141:13 creates 123:13 171:5 creating 97:1 credentials 111:11 credit 222:7 crews 157:5 crisis 13:18 criteria 28:12,20 29:7 30:5 33:12 37:8 39:5,22 41:19,19 48:14 67:15 94:1 101:17 101:19 102:4,11 102:17 103:1,20	104:14,21 105:4 105:19 106:11 107:7,15,18 108:6 110:7 111:16,20 112:8,10,11,13,17 115:3,4,8,22 116:9 117:13 119:7 121:7,15 130:20 131:9,17 critical 41:1,10 47:4 83:19 102:13 146:17 cross 127:20 crowd 8:22 219:12 crucial 17:8 crude 14:17,18 209:15 215:22 crudes 209:15 CSA 50:3 CSEN 50:6 CT 170:17 cubed 104:6 culprit 190:16 curiosity 40:20 curious 41:1,8 current 40:19 86:2 102:17 114:6,11 124:10 155:10,15 172:16 184:2 202:14 203:13 currently 22:1 74:3 75:12 86:16 89:3 91:3 106:12 127:19 192:9 203:9 curve 210:2 customers 188:7 cut 41:14 65:8 93:15 cutting 207:4 CV7 154:14 CVA 63:10 cycling 61:16,21,22 cylinder 32:2 60:1 60:15 61:6,7,9,19 62:3,17 63:5 143:9,9,16 144:13 144:15,21 146:2,6 146:11 148:15 182:19 185:18 cylinders 30:13,20 31:13 32:4,6,10 32:11,12 59:7,7,9 59:11,14,15,17 60:5,6,7,12,14 61:2,13 62:5,10	62:14 63:11,19,20 63:21 64:5,8,8,15 64:16,20,22 65:3 67:4,9 142:9,11 144:6 145:2 146:7 146:10,19 147:7,8 147:15 148:10 149:9,15 150:5,9 151:16 154:12 182:17 Cynthia 2:6 23:20 24:4,10 35:1,19 35:20 56:3 108:22 159:7 161:11 163:21 199:17 203:19 204:13 210:11,14 218:15 222:1 Cynthia's 161:8 <hr/> D D 7:21 202:9 D10 80:13 dabbled 68:13 daily 10:14 180:3 Dallas 147:2,14,20 damage 62:6 142:13,13 147:1 148:1,15,17 174:4 175:3 damaged 62:5 133:3,9 147:19 dangerous 82:7 113:1 193:13 dangers 182:13 data 15:21 46:19 49:14 53:12 54:19 56:10 64:11 67:14 74:22 89:12 90:13 90:17 91:5 92:12 94:6 124:11 163:3 165:21 200:22,22 201:1 203:18 206:20 211:2,2,4 212:20 214:16,21 217:18 218:2 date 16:12 85:1 110:20 130:3 David 43:6,6 day 5:21 10:3 13:18 20:16 21:7 28:3 44:8 87:21 89:9 89:15 90:9,10,11 90:14,19 91:1 139:20 181:22 219:3 220:11	221:18,19 days 27:16 219:2 DC 1:8 de-qualification 63:13 deactivated 182:20 deactivation 182:22 deadly 137:19 deal 4:8 133:12,18 133:20 134:17 135:17 dealing 7:16 132:19 133:21 134:2,22 139:15 deals 39:3 132:5 138:15 dealt 132:15 133:14 dear 84:8 142:14 death 54:13,14 197:14 deaths 55:3,6 159:21 debate 107:15 164:6 debated 107:14 December 43:14 91:3 decide 206:4 decided 28:19 32:21 49:11 decision 42:5 81:10 198:13 199:2,3 decisions 8:6 159:6 199:12 205:9,11 dedicate 21:6 dedicated 17:22 151:10 deem 210:8 deemed 183:8 deeper 42:10 44:3 default 126:4 128:3 defect 63:6 Defense 18:20 23:2 26:12 55:11,16 58:18 108:1,3 162:4 defer 80:5 195:15 define 16:17 defined 85:18 definite 105:3 definitely 41:13 42:6 58:10 78:10 83:5 122:6 212:3 215:5 definition 168:2 definitions 105:8	degradation 108:11 degraded 105:11 degree 145:1 degrees 20:3 29:6 31:20 32:6 41:20 62:2,2 71:1 104:9 175:11 delighted 19:19 197:4 deliverable 110:12 202:21,22 deliverables 158:20 203:3 delving 77:16 demand 139:8 demonstrably 164:15,17 demonstrate 161:14 demonstrates 50:5 demonstration 32:22 33:14,22 39:17 denominator 218:10 density 168:20 dented 104:18 dents 102:7 department 1:6 15:20 18:20 19:16 19:20,22 23:2 26:12,14 36:4 55:11,16 56:9 58:2,17,19 85:15 107:22 108:3 125:20 130:13 162:3 213:16 departmental 16:20 departments 64:7 dependence 108:7,7 162:21 dependent 162:16 depending 13:17 18:6 71:12 100:21 180:7 206:12 depth 41:13 50:21 51:2,5,9,13 209:4 Deputy 3:19 194:17 derailment 14:16 derailments 14:6,7 describe 28:20 29:2 31:4 60:4 described 30:14 37:7 41:17,17 describing 42:6 description 30:4
--	---	--	--	--

39:21	104:2 142:6,7,8	77:11 115:17	doing 13:1 15:17	dramatic 209:14
desensitized 182:20	142:22 143:17	119:13 123:7	23:16 24:14 25:11	draw 39:10,18
design 61:12 142:2	144:18 148:7	126:9	31:6 36:16,21	drawn 101:3,9
158:19 180:8	154:13	Director 4:6 18:12	38:8,9 59:4,20,21	drew 28:8
203:9	devoid 11:17	27:5 209:9	60:2 63:20 65:13	drill 6:9
designed 59:17	DGAC 82:9	disagreement	71:15,19,21 73:14	drive 16:2 17:4
60:16,19	diagrams 37:12	192:20	76:7 78:15 79:1	196:22 201:10
designing 40:21	died 134:20 137:4	disaster 14:16	79:19 94:11 95:16	215:6,7
designs 57:14	diesel 134:18	disbursed 12:14	107:14 113:6	driven 16:9 210:12
177:14	139:12 208:13	disc 144:12,14,14	116:8 120:8	driver 53:15 57:16
despairing 125:3	difference 64:14	145:5,5,9,11	122:12,17 123:1	58:4
destroyed 146:19	71:10 73:19	disclaimer 101:2	129:1 134:19	driver's 57:20
destruction 14:12	126:16	discount 212:11	136:22 149:5	drivers 52:14 57:9
destructive 59:20	differences 124:19	discouraging	170:13 171:4	driving 52:19 213:1
77:5	different 10:15,15	159:16	173:9 180:10	drop 61:16 62:8
detailed 37:8 68:10	10:16 12:11,11,12	discriminators	190:8,21 193:3	64:13 70:12,13
detect 63:13 65:7	13:17 15:20,20	108:5	197:19 201:15	72:4,6,12 157:17
detectable 73:1	28:16 31:16 32:18	discs 147:6	210:2 211:8	173:10,10,13,18
187:10	40:7 41:16 47:14	discuss 209:12	215:11 216:14	174:6,9,13,19
detecting 76:5	57:14 71:7 79:18	215:17	dollar 155:19	dropped 65:8
detection 188:11	83:12 84:2 87:16	discussed 51:10	dollars 79:19	173:20
determinations	87:17 89:21 96:19	88:5	148:16 152:4	dropping 72:13
158:7	107:4 112:8	discussing 51:11	164:12 180:5	drops 55:18 145:20
determine 26:6	114:15 144:9	discussion 56:8	206:19 207:12	drum 93:9 116:15
30:12 31:7,12	149:9,10,14	80:3,4 81:7 185:3	domestic 193:11	116:15
40:12 52:17 53:1	153:22 168:8,9	194:5	216:3	drums 116:14,17
53:14 71:13 75:1	171:6 177:21	discussions 185:1	Don 79:8	dry 6:22
75:8,16 76:3	178:12 179:3	191:10	donated 59:1 66:5	due 34:19 118:2
103:4 118:13	181:1,2 183:18	Disney 133:17	door 99:15	182:22
177:2 182:10	186:22 189:6	Disneyland 138:15	doors 6:1,6	duplicate 62:9
196:10	191:1 214:20	disparity 78:7	dot 60:10,10,13	177:13 220:21
determined 30:19	221:2	display 129:12	63:10 66:13 85:16	duplicated 187:4
77:4 150:19	differently 13:2	132:22	127:20 135:3	duplication 196:5
Determining	200:8 220:3	disposal 136:22	212:2 220:6	duration 205:16
183:20	difficult 8:11 37:17	139:6 213:20	DOT'er 5:2	duty 13:15
detonate 208:20,22	118:2 122:12	dispose 137:10,21	dotting 128:1	dwell 13:4
detonation 103:13	134:10 165:10	disruption 147:1	double 33:8	Dyson 19:5
detonator 103:10	196:16	distance 106:9	Dow 49:1	
detonators 103:20	difficulties 114:7	110:7 115:10	Dr 2:3,4,8 3:7,9,14	<hr/> E <hr/>
detrimental 82:18	115:17	158:11	3:15 8:19,21	e 87:13 90:3 92:19
develop 29:4 73:22	difficulty 116:7	distances 33:11	18:12,14 19:8,12	97:3,8,10 98:11
122:13 126:10	121:16 123:14	104:22 110:1	26:10,11 55:9	eager 216:19
133:15,19	diffraction 46:4	115:16 118:20	80:20 101:3	earlier 34:20 45:1,2
developed 11:1	DiGhionno 2:5 16:3	distracted 13:16	107:22 125:8,10	52:1 66:11 104:7
48:1 50:11 61:5	20:9 24:8,20	distributable 148:3	128:17 129:6,17	118:18 150:2
62:3 170:13	dimensions 41:21	distributing 65:17	131:22 132:2	152:3
developing 122:5	direct 118:1	distribution 17:12	140:3 141:20,22	early 69:14 204:3
122:10,16 123:15	directed 12:4,17	diverse 125:12	142:22 150:2,20	ears 214:1
135:4	137:7	divided 13:17 45:3	151:19 152:19	Earth 172:19
development 1:1,11	direction 16:9 69:1	division 19:20 27:5	154:1,19 162:3	easier 29:5 40:11
22:6 50:3 53:19	83:15 106:16	43:3 103:14 115:2	167:9,10 178:21	73:1 121:8 173:9
209:13 222:19	108:19 215:3	115:3 138:12	179:17 181:11	easiest 18:15 116:2
develops 144:13	219:19,21	208:20,22	188:4 189:10	easily 34:16 79:15
device 143:7,12	directions 106:6	196:14	196:1 204:10	135:20
145:4,7,17 176:3	147:17	divisions 114:15	209:18,22 213:7	easy 121:8
devices 103:19	directly 27:12	docket 6:14 27:12	219:7,10	echo 211:21

<p>echoed 90:4 economic 155:17 Ed 79:8 EDE 46:13 edge 115:1 edges 104:10 educate 137:14 effect 32:5,9 44:17 47:10 52:19 53:7 104:21 105:1 115:4,5,14 117:8 121:4 129:4 148:22 186:3 188:15 208:11 effected 47:12 effective 145:10 150:4 158:1 188:17 effectively 135:7 effectiveness 85:22 142:5,7 178:12 183:20 effects 43:22 45:15 45:20 48:10 74:8 103:21,22 105:12 106:3 effort 11:22 96:4 205:8 220:22 222:2 efforts 11:5 14:4 51:12 78:5 87:12 105:14 Egon 98:6 eight 33:5 42:17 72:4 103:17 169:20 194:1,1 eight-three 89:16 eighteen 156:12 157:4 eighty 150:6 151:3 eighty-four 47:11 eighty-three 89:18 either 7:4 21:22 27:12 28:17 30:10 34:5,14 61:13 80:21 103:9 122:1 124:13 135:1 140:19 154:6,7 164:7 221:20 El-Sibaie 2:3 8:19 8:21 80:20 150:2 209:22 219:7,10 elaborate 32:2 76:15 elect 161:4,5 electric 178:15</p>	<p>electrical 169:2 electronic 57:13,22 93:13 96:10,15,21 97:12 98:12 element 41:1 elements 75:1 97:10 eleven 158:16 else's 55:1 eluded 19:17 email 99:21 100:3,7 141:13 emcee 4:8 19:2 emergency 5:6 89:22 94:19 95:4 95:6,17,18 96:1 99:7 100:22 101:13,19,21 102:14,18 105:5 105:14 106:2,8,12 107:7,17,18 109:5 109:20 110:3 149:20 151:8,10 156:18 201:17 216:7 emerging 208:3 209:22 emission 58:16 63:2 67:12 123:5 emphasis 150:8 employed 73:7 emptied 144:15 encounter 174:3 184:14 214:14 encountered 124:18 encourage 36:19 55:12 216:14 encouraged 111:7 encouraging 124:17 ended 52:1 134:19 146:11 endorsement 166:16 ends 18:9 endurance 173:15 enemies 95:2 enemy 157:10 energetic 114:8 118:22 136:9 181:20 energy 104:19 113:7 114:8 116:6 156:7,7,8,16 158:22 168:20 171:17 203:4,7 enforcement 39:6 86:9 87:18 88:18</p>	<p>89:22 95:5,7,19 99:7 136:4 213:19 engaged 166:14 205:12,12 engagement 196:15 197:5 198:2 engaging 206:2 engineer 43:3 58:15 69:8 engineering 18:13 19:20 20:4,7 37:12 43:2,3 58:19 69:9 141:20 engulfed 147:8 enhance 120:13 142:18 enormous 123:13 ensure 196:18 ensured 32:7 enter 78:20 entertain 128:12 entire 14:10 31:21 149:17 184:9 217:14 entrance 5:14,16,18 5:18 envelope 62:10 environment 8:4 45:4,11 48:5,7 environmental 34:6 132:16 136:15 142:13 environmentally 30:3 environments 45:8 envision 168:4 EPA 87:12 96:9,18 96:19 136:19 199:9 214:17 episode 204:11 EPP 35:6 37:10 equal 19:14 83:16 equation 165:12 equipment 10:4 99:4,7 112:22 172:14 173:3 equipped 143:16 equivalent 86:2 ER 109:11 ERG 109:18 110:13 110:19 201:22 202:2 Eric 208:4 escort 219:8 especially 38:21 78:21 115:19</p>	<p>117:17 118:3 147:14 188:9 197:20 198:3 208:3 209:15 essentially 103:12 103:21 105:9 115:8 116:2,9 117:6 134:12 142:17 143:6 144:12 establish 71:18 82:19 111:11 130:20 131:9 135:10 established 60:10 85:12 establishing 96:20 et 101:16 113:3 124:15 168:12,17 169:4 171:17 172:15 174:4 176:19 178:3,16 183:19 ethyl 182:7 183:7 187:6,8 189:6 Europe 149:2,8 evacuate 189:9 evaluate 73:4 85:21 105:4 134:7 evaluated 55:16 evaluating 86:22 92:4 evaluation 86:4 evenly 118:16 event 20:10,11,12 20:15 116:12 118:9,22 122:19 134:15,21 events 102:15,19 114:8,11,14 116:11,21 117:5 162:21 196:15 eventually 31:14 146:12 147:10 everybody 8:3 14:4 14:22 20:9 28:2,6 42:20 54:22 55:4 71:22 84:12 99:1 143:4 157:8 181:19 196:6 215:1 218:10 220:11 221:15 222:12 evidence 103:14 exact 116:17 exactly 37:19 51:20</p>	<p>59:2 64:1 93:14 144:5 147:5 161:20 187:21 examine 43:16 177:10 examined 170:16 examining 172:10 example 26:16 50:7 102:2 124:20 154:14 158:13 162:8 173:17 204:11 214:7 examples 173:15 exceed 104:15,16 exceeded 117:16 118:14 121:13 exceeding 176:14 excellent 25:14 64:20 67:21 69:3 84:4 154:18 167:6 178:22 exception 143:21 excited 154:21 exciting 72:13 exclude 193:17 excluded 96:5 excluding 95:14 excuse 19:20 86:14 150:22 220:16 Executive 209:9 exist 134:1 existing 99:3,6 211:7 exists 218:6 exit 5:16 expand 131:6,16 154:10 expect 8:22 158:19 166:5 173:20 194:13,14 219:12 expectations 7:1 195:1,12 expected 85:2 131:14 expensive 173:8 205:15 experience 28:5 33:17 50:18 82:11 144:4 experiences 53:15 87:11 experimental 203:17 Experimentally 30:19 experiments 71:10</p>
--	---	--	--	---

<p>162:14 expert 101:20 138:5 164:6 expertise 20:8 experts 35:7 37:11 39:8 101:7 175:10 210:18 explain 50:11 160:7 160:8 explanation 215:9 explore 155:15 exploring 153:4 explosion 103:13 146:13 154:2,9 explosions 167:11 explosive 101:18 103:5 108:1 111:21 117:19 126:3 131:14 132:6,17 150:10 208:20,21 209:1 213:8 explosives 24:11 32:16 35:21 56:4 100:22 101:13 102:15 103:19 107:2 109:1 116:1 126:5 130:16 137:18 139:15 159:8 197:17 202:10 208:11,12 208:18 213:11,17 Exponent 179:22 exposed 33:9 64:17 181:5 exposure 15:13 100:17,17,22 101:12,16 200:15 200:19 express 50:2 extend 19:2 extended 68:10 132:14 extends 185:17 extension 68:4 extent 105:13 206:13 extinguish 34:15 extra 34:7 150:8 extrapolates 123:17 extremely 126:19 135:3 extremes 125:15 127:12</p> <hr/> <p style="text-align: center;">F</p>	<p>F35 20:2 fabricated 30:9 face 135:14 faced 135:18 faces 8:1 14:22 facilitator 217:15 facilities 28:16 70:6 71:6 facility 20:6 93:6 146:6,9 148:3 149:18 152:11,12 173:8 facing 7:15 174:18 fact 19:18 112:20 117:14 144:1 151:7 187:19 191:18 216:18 factor 9:6 12:5 17:19 57:18 61:1 94:22 110:10 factoring 13:6 factors 134:9 149:11 176:18 facts 38:18 40:2 156:10 factually 111:9 fade 182:11 185:11 186:2,7,9 188:21 189:19,20,21,22 faded 182:3 fading 184:2 188:9 Fahrenheit 71:1 fail 111:22 failed 63:6 170:14 171:12 178:2 failing 83:1 fails 170:15 202:12 failure 43:21 44:22 60:1 76:4 177:3 177:18 failures 75:1,2 178:18 fair 12:20 72:21 126:3 215:12 fairly 9:16,16 10:20 11:6 19:18 62:22 143:3 148:6 faith 16:6 fall 107:12 falls 138:16 familiar 32:16 84:20 85:14 121:1 139:20 199:7 familiarity 137:1 198:15 family 131:7</p>	<p>famous 79:13 far 12:13,13 25:12 25:22 64:4,15,16 70:19 72:15 73:12 73:18 74:20 75:12 83:13 106:7 107:17 112:2 123:21 127:10 161:13 172:8 180:13 182:16 fascinating 207:7 fashion 23:7,14,16 33:2 210:22 fast 32:12 129:8 185:2 186:1 faster 182:22 fatalities 146:17 157:3,6 163:2,8,9 201:5 fatality 183:6 fatigue 61:15,21,22 fault 99:18 142:1 fax 99:15,19,20 faxing 99:18 FDA 215:2 FDO 189:16 FE203 189:15 fear 134:10 feasibility 35:10 85:22 114:1 February 98:7 fed 28:21 29:4,15 32:8 34:13 35:11 41:18 156:17 federal 19:12 20:20 86:7 98:18 213:10 213:12,15 feed 30:10 37:21 feedback 23:7 24:22 81:19 85:10 88:7 89:12 97:2 221:10,10 feel 20:12 27:10 67:19 134:12 190:1 206:19 feeling 190:3 Felicia 16:16,17 Felicia's 16:16 felt 9:18 111:5 120:15 fender 157:20 ferrying 141:3 fewer 32:3 fiber 60:11,21 fibers 60:8 field 48:5,7 107:8</p>	<p>122:19 123:8,10 123:17 131:16 fielding 144:6 fields 125:13 fiery 104:15 115:6 fifteen 6:22 59:16 60:19 61:9,13,15 63:11 64:21 67:20 68:8 82:14 115:7 129:22 170:4,6 211:17 fifth 171:10 fifty 9:12 14:9,9 fight 59:8 106:8 107:1 108:4 162:17 166:14 fighter 108:8 113:8 166:15 fighter's 162:10 fighters 59:8 111:15 112:21 151:11 157:5 162:11,17 166:22 fighting 110:5 figure 17:10 29:1 135:6 144:11,17 145:13 177:8 193:22 207:8 210:18 figured 76:21 filed 191:2 filing 191:22 fill 20:16 217:21 filled 143:16 148:5 158:2 186:18 final 39:19 75:19 150:20 154:7,8 finales 128:18 finally 145:13 150:1 172:16 197:17 198:11 find 7:22 53:12 83:16 100:14 101:11 102:17 108:19 109:20 121:22 130:7 135:13 141:3 159:13 189:15 findings 45:12 88:6 92:14 finds 78:8 fine 13:5 17:5 101:8 174:4 205:1 finish 66:1 finished 172:13 finishing 18:17</p>	<p>Fink 3:12 154:21 155:1,1 160:12,22 161:4 164:4 167:4 167:7 203:2,5 fire 4:13,16 5:5 28:21 29:1,8,8,9 29:16 30:4,14 31:1,9 32:1,8 33:9 33:10 34:8,13,16 35:11 41:1,1,9,18 41:18,19 58:21 59:8,8 64:7 65:11 97:20 102:10 104:7,8,9 105:11 106:5,9 107:2,5 108:8,10,10 110:5 111:12,13,15 112:21 113:1,8 115:10,19 116:19 118:15 128:22,22 136:8,10 137:6,13 142:11 146:2,4,8 146:12,17,18,20 147:2,2,5,7,9 148:2,9 149:7,8 149:12,16,21 151:10 152:10,14 153:13 156:11,20 157:5,7,8,9,10,11 157:16 158:2,4 162:6,8,10,11,11 162:17,17,21 166:14,14,15,17 166:20,22 174:4 175:20 177:19,20 177:22 178:3 190:17,20 191:17 193:18 201:2 202:15,22 fireball 104:14 115:5 fireballs 121:19 fired 133:9 firefighter 106:22 110:8 firefighters 63:18 66:14,14,15 93:10 106:7 107:7 110:4 firefighting 105:14 fireproof 175:19,21 fires 108:4 113:3 118:3 148:16 149:21 150:7 156:9,17 160:4 162:18 firework 132:5,7,9</p>
--	--	---	---	---

132:18 133:12,22 135:2 138:14 206:10 fireworks 125:13 125:19 128:6 131:13 132:20,21 132:22 133:2,4,13 134:17 135:6,15 136:6 137:1,11 138:8,13 167:11 firm 131:2 first 9:1 20:19 25:12 28:9 29:4,5 31:10 35:14 38:3 43:18 48:20 53:21 54:8,11,17 65:6 65:12 67:13 77:18 85:8 86:19 89:1 98:2,3,4,12,14 102:3 105:18 109:3 119:22 125:15,16,18 142:6 150:17 162:4 179:3,8,8 183:16 184:7 189:4 196:4 197:7 197:7,22 199:17 205:7 211:21 218:22 219:5 firsthand 14:5 211:2 fiscal 54:12 fit 39:14 135:12 fittings 70:16 73:13 73:20 74:1 five 7:11 44:1 49:8 68:9 102:10 104:16 105:21 112:8,10,13 113:1 113:1 126:7 127:11 130:4,10 130:12 134:20 137:4 140:14,17 169:18 185:21 194:7,9 217:18 218:1 fixed 156:13 flammability 123:6 flammable 14:1 111:22 123:4 142:8 150:7 162:16 163:20 flash 129:11,13 flatter 118:18 flavor 12:16 flaw 61:16 62:4	flexibility 69:18 flexible 201:20 flicking 218:16 float 81:6 floating 81:15 floor 69:5 173:11 173:14,18 174:7,9 174:10,14 195:20 195:21 Florida 146:3 150:19 152:10 flow 31:1 41:5 211:1,5 212:9 218:1 fluorinated 178:15 flux 114:9,14 115:15,17 117:15 118:14,19,21 119:4,10 121:4,6 121:14 122:2 124:20 FMCSA 52:18 FMCSA 43:6,7 52:13 focus 39:10 48:15 51:8 57:15 58:3 163:7 165:22 181:9 192:22 focused 88:17,19 90:2,5 94:13 160:8 focusing 83:20 138:22 folks 18:19 66:3,5 87:22 follow 11:9 69:1 94:5 108:18 126:8 128:8 166:11 206:3 followed 84:21 89:8 166:2 following 6:14 63:9 87:20 follows 11:8 136:18 food 140:21 foray 35:14 forbidden 103:5 force 172:18,19 173:19,20,22 174:3,7,8,14,17 176:1 forced 41:5 forefront 191:14 foremost 9:2 20:19 183:16 184:8 forensic 170:13	171:12 176:22 179:21 180:6 forensics 180:3 forget 19:5 forgive 17:17 form 88:6 164:7 213:10 format 198:5 format 120:2 167:13,18,21 formatted 23:5 former 98:8 formerly 47:21 101:4 forms 141:10 Fort 200:4 forth 153:19 163:16 164:1 fortuitously 161:16 fortunate 10:20 fortune 188:6 forty 9:12 22:16 100:21 157:2 forty-five 60:17 63:19 64:1,4 forty-two 159:15 forum 1:1,11 7:9,21 21:12 24:16 26:20 27:13,14 101:6 178:8 194:18 197:22 199:21 209:11 222:19 forums 38:11 forward 7:15 11:22 13:7 16:8 23:8 25:3 50:10 98:11 153:15 159:14 160:17 198:1 199:6,13 216:9 222:13 fought 162:11 found 44:21 45:15 46:10 47:2,3,5,10 47:15 52:14 72:7 78:18 122:17 125:18 126:8 193:1 fountains 6:4 four 31:6 33:17 46:21 102:10 104:18 114:22 115:6 116:21 140:12 144:10 148:16 157:2 fourteen 116:19 118:10	fourth 133:4 170:20 171:10 175:8 204:5 FPAC 19:14 FRA 9:10,11,13 10:5 fragment 107:5 frame 71:14 frankly 15:11 31:16 free 27:10 66:18 212:12 freeway 147:16,17 freight 215:20 frequency 55:17 203:12 friction 103:3 friendly 30:3 friends 18:16 58:2 front 58:7 fruit 121:5 fruition 96:11 fuel 28:17,18 29:8,8 29:11,13,16,16,19 29:19,22 30:18 32:15 34:4,5,15 34:17 35:12 41:8 41:18,18 146:12 156:12,17 158:10 158:11 208:10 fulfill 167:15 full 16:6 17:21 33:13,20 93:11 136:7 178:6 194:13 214:8 fully 15:18 60:8,11 function 148:7 154:13 functions 154:15 fund 26:6 fundamental 61:18 186:5 funded 9:18 25:14 25:21 122:9 funding 9:9 25:1 198:12 220:18 funds 207:13 funny 204:21 further 20:8 28:8 52:20 74:18 77:3 77:3 81:3,14 122:6 167:17 179:18 180:12 fused 206:8,15 fusible 144:18,20 144:22 145:1,3,5 145:11 147:6	future 12:2 21:8,8 21:13 25:2,21 50:10 51:11 74:15 90:6 92:19 204:20 213:2 FY14 24:13 <hr/> G <hr/> G 138:9 172:18,19 172:19,20,21 173:19,20,21,22 174:2,7,8,14,15 174:15,17,20,21 174:22 175:1 176:1,8,9 G's 176:4 gap 102:17 106:10 109:17 111:15,18 gaps 75:3 88:14 102:22 garnered 183:4 gas 28:21 29:4,9,15 30:1,10,10 34:13 35:11 41:18 67:2 123:4 143:16,21 150:7,17 156:3 181:21,21 182:2 183:9,22 184:9,10 184:10,15 185:8 188:22 191:8 207:5 208:5,18 gases 70:15 gasses 41:5 72:20 72:22 142:9 143:20 152:16,18 gathering 90:18 gauge 67:16 gauging 62:15 gear 106:21 113:9 gears 167:12 general 38:17 72:19 90:3 106:7 120:15 139:7 186:5 190:14 203:13 generally 24:11 111:9 120:7,19 149:6 203:22 204:7 generated 132:10 gentleman 192:19 gentlemen 66:10,17 Gentry 3:11 152:7 152:7 188:18,18 getting 19:13 26:22 38:1 64:22 65:14 67:22 103:1,1
--	---	--	---	---

116:18 124:3 147:8 159:2 163:1 164:11 190:2,9 216:12 give 12:20 18:4 20:16 21:3,7 22:2 22:21 34:3,4 69:13 81:8 93:14 101:1 138:17 140:5 141:4 173:17 201:20 205:10 212:12 216:15 219:8 221:7 222:5,7 given 13:12 32:5 34:17 35:2 74:10 115:21 142:3 153:6 160:3 161:17 182:3 212:17 218:13 220:18 gives 20:7 29:16 34:6 178:5 giving 24:1 55:18 81:17 204:8 glad 181:19 199:22 glass 60:22 globe 196:11 go 5:12,13,19,22 6:6 7:15 9:5 21:4 21:13,20 22:5,14 23:15 25:3 26:21 35:14 40:14 44:3 51:9,22 52:20 54:18 61:9 63:15 72:15 81:3 93:17 98:11 104:13 105:22 106:16 108:19 113:20 114:2 115:13 116:15,15 124:21 126:2,18 130:16 131:21,22 134:13 138:20 139:9 140:8,9,18 143:9 148:20 150:2 151:17 152:8 158:22 162:1 163:13 165:21 169:7,22 172:2,4 172:14 173:14 175:5,6 179:1 181:14 187:15 189:2 198:14 200:21 209:1 210:17 217:6	goal 68:3 85:21 110:19 135:9 155:14 220:7,13 220:20 goals 13:8 68:14 131:4 220:4,5,14 God 201:10 goes 4:16 18:22 55:20 65:15 70:19 73:12 74:21 75:13 132:13 144:20 172:21 174:16,17 175:2 183:13 194:9 200:17 214:17 Goettee 43:6,7 going 4:3,10 5:12 5:21 6:13,21,22 7:8 9:2 11:12,13 12:8 18:21 20:11 20:13,22 21:2 23:10,21 24:5,6,8 24:17,21 25:7 26:5,6 27:7,19,20 28:5,7 31:15,20 34:8 35:2,5 38:16 40:6 42:16 45:22 46:12 48:12 55:10 58:14 59:12 65:14 65:16,18 66:1 67:13,15 69:10 72:3,8 76:10 77:5 78:4,14,15 81:16 84:15,15 85:7 90:12,16,20 91:18 92:3,6 93:15,16 94:1,18 95:5,19 96:20,21 97:11 98:3,11 99:4,10 104:3 105:9 108:2 108:9 109:7 110:14 111:2,9 113:5,12 116:6 119:15 124:5,6 125:12,13,14,16 129:2 131:8,20,21 134:11,19 135:12 136:3,16,17 138:2 139:19 140:1,2 141:17 150:21 152:15,20 153:3 155:13 156:16 158:6 159:5,15 162:4 164:11 166:12 167:8,12 169:7,22 170:18	173:2 174:3 179:15,16,22 181:14,16,17 189:3 194:6,6,19 195:9,17 196:7,11 196:13 197:10 198:1,9,12 199:5 199:12 202:22 205:1 206:2,18 207:17 208:8 210:11,20 215:4 218:16 219:5,7,10 221:9,19 222:2,14 Goldstein 3:4 97:18 97:19 190:14 192:13,16 193:18 golf 189:1 good 4:2,2,4 8:18 8:21 9:17 11:11 16:15 20:9,12 23:5 26:14,22 36:22 40:21 42:17 43:1 47:20 52:9 55:4 58:11 65:10 68:21 69:7 75:10 76:6 77:5,12 78:16 81:10 83:21 84:11 89:20 93:22 94:2 97:17 100:19 101:22 113:5,20 125:7 129:16 131:20 137:15 140:7 141:22 148:20 149:20 155:2 158:19 164:2 167:10 180:10 188:20 193:11 200:3 209:12 211:3 215:1 216:6 217:3 219:12 221:1 Goods 82:7 gosh 221:12 gotten 201:19 gov 100:5 government 8:13 9:18 10:5 25:15 43:6 78:22 136:22 193:13 198:19 212:5,11 213:6,11 213:15 gram 130:10 grant 201:20 graphically 14:3 grateful 199:20 gratitude 19:2 50:2	gravity 56:11 great 22:20 23:3 24:18 25:11 42:14 42:22 49:21 51:21 57:13 80:12,17 82:12 84:4 100:6 100:9 124:22 125:4 154:18 162:2 215:17 216:13 221:15,15 222:12,13 greater 12:13 69:18 104:20 115:6,7 168:2 greatest 16:11 150:9,10 152:5 Greg 2:11 40:17 122:7 grid 31:5 grill 185:22 groggy 173:16 ground 194:5 195:12 group 16:16 95:16 96:2 197:20 213:14 groups 87:18 89:20 91:20 216:22 grow 13:9,10,11 growing 13:10 growth 43:17 216:3 216:6 Guard 214:10 guess 48:20 74:14 120:9 126:11 138:19 139:13 142:19 148:8,12 148:13,18 150:1,5 188:4 190:15 206:9 214:5 219:6 guessing 129:21 guidance 81:14 106:1 109:12 139:14 188:7,10 guide 73:22 106:2 guidelines 137:10 guise 132:17 Gupton 2:14 48:18 48:18 49:7,17 gusts 73:16 gut 190:1,3 guy 188:19 guys 4:4 5:7,18 36:20 42:17 51:21 100:9 106:18 108:17 140:14,17	141:5 158:3 179:14 180:19 191:10,13 194:7 195:22 202:11 207:14 210:15 <hr/> H <hr/> habits 5:20 half 17:21,21 30:8 31:2,4 45:4,5 108:10 hallway 6:2 79:8 halon 177:20 hand 5:11 35:14 212:6 handed 57:2 handle 26:19 126:6 131:3,15 214:7 handled 125:19 130:2 140:2 handling 149:10 hands 117:12 125:1 162:13 182:14 192:12 195:21 hanging 121:5 happen 12:1,2 166:5 175:12,13 175:14 191:20 222:8 happened 11:22 134:16 146:9 147:13 159:18 177:9 185:16 188:1 happening 148:18 185:5 186:7 191:19 happens 5:1 47:5 96:4 175:14 214:15 217:4 218:13 happy 20:18 98:21 150:13 192:11 212:10 hard 115:20 183:14 185:1 187:17 214:20 harder 197:6,11 harm 15:11 harm's 162:13 167:2 harmonization 107:15 harmonize 69:15 171:4 Harvard 198:19
---	---	--	--	---

hate 220:17	held 85:9 87:21 179:16 199:20	HMR 69:22 72:18 73:9 171:2	133:6 146:17 168:6,7 170:3 183:1	images 126:14 imagine 14:20 101:21 109:3 196:12 205:20
Hawaii 134:16 139:8	Hello 38:4,7 110:22 125:10	HNCRP 40:19	hundreds 206:18	IME 199:17
haz 96:14,14	help 6:13 11:14 16:16 55:8 84:14	hold 24:5 83:15 91:16 204:1	hurt 81:14 112:18	immediate 105:15 105:19 106:4 112:16
hazard 84:9,16 85:6,19,22 110:7	helped 65:18 66:4	holder 87:18 89:20 91:20 159:4	Hwang 3:14 167:9 167:10 178:21 179:17 181:11	immense 14:20
hazardous 8:5 25:12 54:15 69:9 85:4 86:6,15,20 87:15 88:13,21 94:21 96:10 97:9 97:14 112:1 155:8 162:15 194:16 215:14	helpful 81:6 179:19	holders 17:10 86:6 86:21 87:7,15 89:2,10 93:3 151:22 153:1,2 155:20,21 159:5 197:7,8 198:22 204:22 205:6 206:3	hydro 178:14 186:22	impact 64:15 90:18 92:9 103:3 152:5 155:17 191:21 208:5 220:8,8,9
hazards 168:22 169:1,2 170:2	helping 55:20 66:4 151:12	holding 31:7 70:20	hydrogen 54:3 157:16,17 162:8	impacted 65:9
hazmat 4:7 8:1,20 10:13,14,21 11:6 12:8,10 13:22 14:2 20:6 55:3,6,7 58:15 64:8 72:3 80:6 86:10 96:15 199:3 215:20 216:17,21 218:4 222:6	helps 221:7	Homeland 20:1	hydrostatic 73:12 73:14 74:7	impacts 34:6 52:17 86:5,12 87:1 89:5 92:5,12,15
head 41:12 46:5 47:2	Hess 124:16	homework 215:11 215:12	hydrous 45:9,9,11 48:9	impedes 176:16
heading 195:14	hey 165:7 206:14	honest 84:13	I	implementation 87:1
headquarters 87:21	hi 23:18,20 35:18 40:17 217:11	hope 12:14,18 16:13 141:15 183:11 210:7 211:9 222:3	IAN 215:13	implemented 213:5
heads 199:14	high 31:17 46:6 54:20 60:18 83:1 143:9 163:13 164:16 165:3,4,10 168:19 174:7 188:16 198:13	hopeful 28:2	IBC 70:20 71:11	implementing 87:8 87:12 88:3,15 92:3
headway 58:3	higher 62:11 70:15 79:21 116:7 118:8 164:18 216:17	hopefully 5:8 84:11 109:20 125:4 131:10 192:1	IBC's 72:1 74:19	importance 79:6 217:1
hear 4:4 7:10,13 8:7 16:5 24:18 37:22 84:12 125:11 149:7 160:11 161:6 194:14 202:20 206:1 219:16	highest 206:5	hoping 63:9 108:14	IBCs 70:13 75:19	important 4:12 36:18 82:11,13 108:8 112:6 123:10 162:19,21 169:21 182:12 191:16 192:7 196:5 197:5,16 200:13 208:2 210:10 222:2
heard 27:17 88:7 97:3 98:3 152:3 175:9 193:10 196:4,8,20 210:9 211:22	highlight 53:7 88:13	Hopkins 2:18 63:17 63:17 64:6,12	idea 22:22 23:4,6,8 26:18 37:4 43:15 68:3 72:3,10 81:6 81:16 122:19 131:10 178:5 195:4 204:3 207:19 208:4 209:20 214:8	imported 193:11
hearing 120:17	highlighting 115:3	horrible 134:15 195:8	ideas 10:2,4 20:14 22:2 24:17 25:16 25:22 26:14,22 27:17 42:13 125:5 201:22 209:6 213:13,21 214:2	impress 219:17
heart 84:8	highlights 169:18	hot 15:12 41:5	identifiable 116:10 116:12 117:5	impressive 11:11 120:2
heat 44:1 45:21 47:6,10,12 64:17 65:7 112:10 115:9 116:6 156:4,14,21 157:9 175:10 181:5	hill 201:19	Hotel 189:7,9	identified 65:3 89:13 90:4,14,15 91:10,15 153:8 161:12	improve 53:3 55:21 155:11 176:20 177:18 217:21
Heckman 3:8 135:20 139:1 205:21,21	Hilton 2:6 24:10,10 25:5 35:18,20,20 35:20 56:3,3,22 108:22,22 110:12 120:6 159:7,7 160:19 161:1 165:16 166:10 199:17,17 203:21 204:2 217:22	hotter 29:18	identify 57:9 75:1,3 94:1 102:21 114:10 183:11 186:8 204:8	improved 113:15 202:1
height 62:11 173:11 174:17 175:1	hinder 105:13	hour 108:10 156:18	identifying 184:6	improvement 38:16 78:6,11 155:12
	hindering 109:22	hours 7:6 46:21 108:10	IFC 66:10,18 190:17,20	improvements 38:9 69:20 120:20
	historically 105:22	Houston 168:14	ignite 126:18	improving 20:14 38:10 39:1 114:1 119:16 155:2,9 202:16
	history 4:22	hovering 194:8	igniter 103:11	in-house 71:7
	hit 205:19	huge 9:15 10:12 78:7 134:13 160:3 168:11 171:20 174:5 200:13 218:11	ignored 134:13	inaugural 20:10
	hits 176:4	human 25:8 52:14 57:18 184:11	Igus 35:6 37:10	inbox 100:2
	HM 52:12 84:17 85:3,7 87:7 88:21 197:10	humans 184:13 220:9	illegal 137:17	inch 79:14,17,20
	HMCRP 25:20 27:2	humble 19:11	illusion 9:15	
	hmmm 159:19	hundred 44:2 45:3 49:8 66:20,21	image 126:16	

127:1,9,11 129:4 134:4 175:8 inches 126:2,7,7 incident 52:19 53:10 54:18,19 93:10 134:20 150:18 151:16 159:16,17 170:7,8 182:6 183:4 190:18 208:12,13 incidents 53:10 54:13 110:4 149:1 151:3,4,4,11 157:1 159:20 161:19 170:4 182:1 185:10,16 193:1 201:2,4 206:10 include 14:1 19:21 20:5 106:20 included 90:19,21 97:10 includes 61:15 70:7 151:22 including 57:6,7 86:7 92:16 95:17 103:18 incorporated 129:20 incorporating 96:13 incorrect 50:22 99:16 110:21 increase 32:11 208:9 209:14 increased 208:5 increasing 62:11 incredibly 137:19 213:5 indentation 102:5 independent 11:13 11:17 55:22 98:8 indicate 221:7 indicated 41:3 96:11 172:1 indications 47:1,10 47:11,15 indirectly 49:5 individual 74:10 87:14 116:20 118:9 individuals 88:4 indulge 13:5 indulging 18:3 221:14 industrial 76:14	80:10 83:18 133:21 166:1 industries 12:11 152:8 188:19 industry 8:1 11:2,2 11:8,13,18 12:4 14:22 16:20 17:9 25:15,22 26:16 32:17 43:10 48:22 50:2 51:1 53:4 54:22 55:5 69:18 72:12 73:11 77:8 77:10 78:8,8 83:6 86:10 88:19 89:22 95:4 101:6 127:9 132:7,7 133:17,21 135:2 136:2,14,18 137:3 139:2,13,20 145:22 151:8 159:9 160:8 165:1 166:3 174:18 197:4 198:18 200:5,7 205:5,6 205:19 206:10 207:5,11 210:13 212:5 213:6 216:4 216:7 218:3 219:3 220:9,11,22 221:6 221:8 industry's 50:5 inexpensive 158:5 inexperienced 50:16 inferno 142:12 146:4 influence 179:5 inform 205:9 informally 28:13 information 24:3 36:3 37:3,9 48:1 78:13 83:10 86:15 87:10 88:10,12,12 89:4 90:16 92:4 95:8,18 97:9,13 141:14,16 150:22 151:18 213:1 219:4 informational 90:4 ingredients 10:8 inhalation 143:21 inherent 8:5 155:7 inherently 107:12 131:13 initial 62:19 81:12 87:5 152:9 153:19 initiate 103:9 107:6	initiation 103:10 initiative 11:21 85:11 initiatives 70:10 injured 66:15 110:5 injuries 146:16 147:17 163:10 183:6 injury 54:13,14 142:16 inlets 30:9 inner 33:5 116:20 116:21 118:12 Innovations 198:19 Innovative 85:16 input 11:18,19 17:6 18:5 38:12 98:20 151:21 155:19 159:4 162:2 178:8 210:18 inputs 16:19 17:8 17:11 inside 55:15 82:16 160:14 170:18 175:12 177:1 inspect 10:3 46:15 147:19 inspection 45:16 48:14 68:10 94:18 129:2 inspections 129:1 instance 95:15 102:2 105:20 106:19 118:10 121:8,9 123:3 instances 182:2 Institute 24:11 35:21 38:6 56:3 108:22 111:1 159:8 instructions 140:5 141:4 instrument 175:16 instrumentation 124:11 175:19 instrumented 33:10 insulation 157:11 157:18 164:14 insuring 15:1 integrated 98:13 intend 106:15 intended 137:17 154:15 intense 45:6 intensive 29:9 intent 84:21 86:11	152:1 211:10 220:21 intention 148:20 intently 180:2 interactions 212:17 interactive 218:20 interagency 85:12 167:14 209:9 intercede 194:22 interest 12:5 82:12 96:3 138:1 183:5 214:6 interested 35:22 38:9 93:4 106:17 106:20 157:15 163:1 202:6 211:14 213:17,21 214:5 221:7 interesting 143:3 153:14 158:5 interim 197:19 interiors 170:17 intermittent 127:14 internal 177:5 internals 177:8 international 17:1 63:18 65:11 81:5 97:19 111:13 128:21 153:12 166:16 168:13 177:15 193:18 215:7 internationally 117:21 interpret 7:19 109:22 interpreted 39:7 interrupt 18:10 221:18,20 Interstate 147:13 intrinsic 123:16 introduce 8:19 19:17 58:14 84:10 125:8 introduction 58:13 66:13 introductions 28:1 introductory 35:3 investigate 178:14 investigated 169:15 investigation 36:16 136:21 178:18 investigator 40:18 122:8 investigators 40:18 invite 14:14	invited 17:15 180:14 involve 201:5 involved 49:5,5 50:4 77:8,11,12 83:7 95:2,11 111:7 147:2 182:3 189:4,14 190:18 involves 86:21 186:6 involving 52:13 54:13 80:16 91:19 102:16 185:16 201:4 Iowa 43:9 49:15 50:17 Ipad 100:14 ipads 99:17 iron 214:18 irradiance 34:13 is-is 174:9 isolated 11:18 isolating 106:5 issuance 177:14 issue 13:22 15:12 70:4 126:1,9 127:5 128:5,10,14 128:14 129:10,13 152:22 160:15 165:6 166:18 170:22 172:7 185:9 186:20,20 187:19,19 189:11 189:12,16,16 190:15,22 191:11 191:16 207:2 220:19 issued 133:16 171:9 issues 13:17,19 15:3 15:8,9 26:3 97:20 97:22 118:2 123:13 128:6 130:19 160:3 165:3 178:19 184:5 185:11 211:19 216:20 221:6 ISU 46:13 Italian 140:15 italics 105:16 item 21:14,17 22:13 items 9:20 12:16 131:12,17
J				
Jack 67:1,7,22				

limitations 26:21	109:5 114:5,19	160:15 163:9	80:14 83:22 92:21	Magdy 2:3 8:19
limited 14:19 56:6	115:5 129:21	165:2,8,21 168:5	97:2 98:9,20	18:9 19:17 25:18
58:12 68:7 77:14	130:6 143:2 147:9	168:7 171:8,11	99:17 105:22	27:4 28:1 35:1
92:10 94:3 105:12	149:9,10,16 150:8	172:16 176:12,17	108:3,14 115:18	222:3,5,11
149:16 150:3,12	154:1,3 163:22	177:1,17,19 178:1	117:3,11 121:15	main 5:14,18 69:21
159:13 160:19	167:18 173:16	178:5,6 179:6	126:16 128:18	maintain 30:22
165:9,19 185:9	190:15 194:10	185:4 186:11	129:7,9 130:18	major 20:5 84:22
196:16 197:9	204:7 206:20	187:20 189:11	132:11,15,16	86:18 103:22
198:12 203:6	207:4 209:4 211:2	190:4 192:11,20	146:22 147:21	majority 57:10
207:13 213:12	211:2 218:18	193:5 199:12	148:1,13 149:16	89:16 104:4
limiting 94:22	live 14:12 166:7	200:5,14,17,22	152:17 156:6	135:14
line 29:3 76:15	201:8	207:4	162:15 163:8,9	Majors 2:12 42:22
105:7 136:7	lived 10:6	looked 28:7 38:15	165:13 169:12	43:1,2 48:6 49:4
142:19	lives 14:10 66:21	48:7,10 67:14	171:5 175:11,13	49:12,20 50:17
liner 60:9,10,12	71:18 160:1,5	96:16 109:4 121:3	175:15,18 176:14	51:4,7,16 52:7,9
Liners 60:20	166:18	121:3 125:2 153:7	178:4,19 181:6	52:10 54:16 56:2
lines 33:22 190:13	LNG 208:5 216:2,3	172:12 189:6	183:4,12 184:16	58:8
lining 102:13	lo 79:16	190:5 208:8	187:2 188:20	maker 49:2
linings 183:18	load 66:18	looking 13:7 14:15	190:22 191:16,18	Makers 24:11
link 22:9 100:1,5	loaded 145:17	22:3 24:21 25:1	191:20 197:18	35:21 56:4 109:1
linked 101:17	186:12	41:4 48:2 53:9	202:8 210:9	159:8
193:15	loading 55:14,19	56:13,14 57:20	211:18,21 212:9	making 51:21 58:2
liquefied 152:16,18	loads 134:2,17	64:16,20 71:2	215:17,22 216:2	81:10 109:16
181:21 208:5	local 49:17 136:4	74:16,17 76:17	216:18 217:2	117:18 198:2
liquid 14:1 28:18	136:10 137:12	77:7 91:8,11	222:7	199:2,3 222:7
29:8,16,19 32:18	located 144:5	94:12,15 96:12,22	lots 82:22 149:15	manage 83:15
34:4,15 35:12	location 102:9	97:1 101:5,14	158:15,17,17	166:4 200:8
41:18 45:5 157:16	143:18	103:12,21 104:21	love 80:8 141:10	managers 17:8
183:7	locations 95:8	110:20 114:4,5,8	160:7 193:4	manages 133:6
liquids 111:22	Lon 3:6 124:15	115:11 117:18,20	200:22 201:1	managing 16:4
123:4 163:20	long 9:3 22:16	119:3 121:16,18	202:1,16	109:13 167:22
list 2:1 3:1 36:4	26:21 29:8 34:8	122:10 124:1	low 54:20 121:5	mandate 35:9 93:18
38:3 66:6 196:7	37:18 54:9 55:20	127:12,20 133:15	145:2 158:2	mandated 187:12
listed 30:6 49:1	71:2,3,9,14 75:22	150:8 154:11,14	163:12 165:2,11	manifest 87:13
67:13 182:5	80:7 94:5 125:21	160:5 161:13	198:14 206:7	96:10,15,18 97:8
listen 98:10 218:17	129:18 222:8	163:3,6 165:17,19	lower 46:8 69:19	97:10
listened 198:8	longer 25:14 42:10	166:13 170:15	116:3 123:5	manifold 152:13
listening 97:22	105:21 116:4	172:6 175:4 177:8	loyal 47:6	154:5
150:13 164:5	218:5	181:2 193:2	LP 181:21 182:2	manual 28:12,20
200:1	look 5:1 10:7 11:22	200:19 202:7,17	LPG 182:12,15	29:7 30:5 37:7
liter 60:16	16:7 17:3,5 22:10	206:13,22 207:13	183:9	39:4,22 41:15
literally 39:20	28:21 30:5 48:3	221:6 222:13	Luckily 114:17	42:3 102:3 105:19
literature 188:1	50:9 52:22 73:2,7	looks 24:15 74:14	Lucy 2:5 16:3,4,5	115:21 116:9
190:8	73:21 75:16,20	147:6 153:13	19:17 20:2,8	119:6 124:20
lithium 167:13,18	76:4 78:19 82:18	167:10 178:10	25:12 27:12 28:1	176:18
167:21 168:19,21	86:16 93:10 111:8	loop 146:11	120:3 195:13	manufactured
170:21 171:1	115:22 117:3	loose 132:8 171:1	lunch 131:20 132:1	200:11,12
178:22	120:9 122:4 123:5	Los 46:3 207:19	140:4,5 141:6	manufacturer
little 6:5,7 13:4	124:6 126:11	lose 5:13	lying 210:1	159:11
29:14,17 30:1,2	127:6,14 133:13	lost 4:10		manufacturer's
31:20 32:17 33:18	134:7 138:5,7	lot 4:10 6:16,17	M	93:6
34:6,11 40:11	139:10,15 142:3	8:11 10:22 12:14	M80's 137:18	manufacturers
42:18 52:1 53:21	146:1 148:12,18	15:14 16:15 17:5	ma'am 23:17	38:6 61:17 111:1
54:19,20 62:11	148:22 151:17	22:16 29:5 50:4	machine 173:5,6	169:13,15 180:16
64:3 69:13 76:16	152:21 153:15,21	56:8,10 59:20,21	machines 99:20	manufacturing
90:7 94:8 103:20	157:22 160:4,13	70:2,2,21 78:5,21	MAE 67:15	20:6 74:18 132:10

120:16 181:9	222:11	noble 8:14	numbers 37:3 56:1	182:1,9
narrowed 120:11	needs 13:13 16:15	Nobody's 167:5	95:1 103:17	odorized 182:2,7
national 47:22	16:20,20 79:17	noise 115:19 118:16	nurse 42:21 43:4	183:9,22,22
66:20 85:13 137:6	86:4,16 87:2 88:3	nominal 136:5	44:7,11 46:9,17	odorless 182:12
150:16 153:16	91:21 94:13 108:8	non-compliant	46:18 48:15 49:13	off-road 56:11
185:7 188:22	109:16,19 112:2	133:1	nut 138:2	offer 72:16,16
190:17 217:5	113:14 116:4	non-destructive	nutshell 115:2	149:8 207:2
221:12	139:2 179:12	59:22 60:3 62:18		offered 69:17 203:9
nationwide 136:3	201:22 215:10	non-prescriptive	O	office 8:1 15:20
natural 41:9 98:19	218:10 221:8	39:5	O'Neil 2:16 50:13	69:9
184:9 208:5	negative 203:11	nondestructive	50:13,20 51:6,14	official 194:15
Nauman 2:22 80:9	neighbor 14:8	61:11 62:13	51:18	officially 48:10
80:9,16 83:17,18	Neil 200:4	nonspecific 41:19	object 72:5 219:19	129:21
Navy 58:18 167:15	net 98:3,3,11,14	noon 18:4,5	objected 119:18	oh 35:1 42:21 99:14
171:8,21 172:2,13	network 98:4	normal 52:1 129:12	objective 25:17	195:4 221:12
Navy's 20:1	neutron 46:4	normally 193:16	85:10	oil 14:1,17,18 46:16
near 84:8 201:9	never 93:7 149:7	north 14:9 80:10	objectively 210:19	48:5,7 148:5
nearby 142:17	189:20,21	190:19	219:18	158:2 209:10
148:8	new 1:7 5:7 18:16	Nortico 50:13	objectives 59:3	215:22
necessarily 17:6	19:18 20:6 22:8	note 33:16,18 39:4	179:2	oils 209:15
29:11 35:9 40:6	22:13 42:4 61:7,8	116:8 117:3	observation 55:7	ok 118:11
40:14 71:20 101:9	61:19 62:10,22	161:10 197:12	observations	okay 6:16 18:10
124:1 126:15	110:13 111:8	noted 40:5	122:11	24:5,10 25:5
132:9 136:1 164:1	113:22 114:10,16	notice 1:12 89:9,9	observe 17:7	35:18 37:3 50:20
182:15 187:4,11	118:4 122:10	89:13,15 90:7,9	obstacles 88:3	56:2 78:1 84:12
necessary 18:11	123:15 130:21,22	90:10,11,14,15	obtain 87:10	110:12 125:11
30:13 70:22 82:20	133:14 178:2	91:1 95:13 152:22	obviously 13:5,9	142:5 156:10
102:21 114:14	183:17,18 184:4,6	191:12	17:4 30:16 31:19	194:7 195:19
127:15 161:17	184:7 186:8,20	noticed 45:12	32:17 72:8,14	196:1,4 202:8
210:8	187:5,14 191:13	notices 91:10	77:4 101:15	203:21
need 4:18 7:14,14	193:7 199:10	notifying 89:9	183:17 191:21	Oklahoma 148:3
9:5 11:12,14,19	newer 184:19	novelties 125:14	196:14 222:3	200:4
11:19 15:8,15	186:21	129:17,18,19	occasions 186:11	old 18:17,18 58:15
16:9,10 17:13,18	news 157:5	130:4,12,14,21	occupy 13:20	61:6 130:2 188:19
26:18 28:21 30:4	NHTSA 58:2	131:2,9,16 135:21	occupying 13:20	190:3
30:20 35:19 37:13	nice 32:15 33:18	206:8 207:1	occur 14:7 91:22	older 47:16 186:21
41:9,20 52:20	55:22 108:1	novelty 128:14	95:1,10 102:20	OMB 91:4
66:2,5 80:5 81:1	Nicklous 2:9 27:20	130:9 131:3,6,11	127:11 182:18	OMB's 91:4
81:18,18 94:13	27:22 35:19 37:5	206:8 207:1	186:15	once 5:10 68:9
98:19 108:20,20	39:15 41:11	November 90:8	occurred 52:20	74:11,14 91:4,15
110:6 127:14	181:18 185:15	91:1	53:11 63:14	92:11 97:12 106:9
129:12 134:4	187:21 190:7	NP 133:18	134:20 150:19	112:3 116:6 119:1
135:7 136:14,18	192:7 197:14	nuclear 51:1	152:10 157:7	122:7 144:13,19
139:21 140:5	Nicklous's 181:15	number 30:12,13	191:19	145:15,17 146:8
160:5 163:15	night 146:3	31:13 32:4,10	occurring 215:19	186:16 189:21
164:18 165:8	nimble 204:16	52:14 53:3 54:19	October 43:19 53:9	216:10
167:16 172:7,15	nine 148:12,12,13	55:1,6,20,22	odor 185:11 188:11	ones 46:20 53:21
176:20 187:20	ninety 47:1 87:14	57:10,11 59:14,19	188:20 189:19,20	136:11 144:11
195:8 198:4	nitrate 155:3,4,4	65:1 70:5,9 71:6	189:21,22	145:14 148:14
200:14 201:21	156:2,2,4 160:13	72:16 82:10 83:14	odorant 182:2,11	206:5,16
202:3,4 204:16,18	160:14 164:15	93:3,20,21 94:10	184:4,6,7 186:2	ongoing 24:18
207:11 210:4	200:7	94:13 99:16	187:5,9 188:17	53:18,19,22 58:6
215:11 219:17	nitrogen 45:11	120:13 122:12	193:7 207:6,9	58:17,19,20 59:1
221:4	nitroglycerin 160:2	138:12,14,17	odorants 184:2	69:11 70:9 79:2
needed 30:15,20	nitrous 156:3	139:2 151:14	189:6	82:12 84:16
31:13 145:7 222:9	NLPGA 188:21	172:21 197:13	odorization 181:21	169:17
		203:11		

onset 81:11	171:22	packet 90:22	parenthesis 105:20	pay 15:8
open 26:20 27:7	outcomes 28:4 85:2	page 22:16,20	parked 140:21	peanuts 181:4
51:16 54:6 92:9	outlined 137:9	104:13 215:9	part 36:13 44:9	peer 43:12 216:15
92:22 94:11	outlines 179:2	paggers 98:12	49:1 57:17 78:22	peeve 79:5
107:13 108:13	output 112:10	paid 220:12	85:15,16 90:13	pen 81:18
122:5 145:15	114:7 115:9 116:6	pallet 134:2,17	92:8 97:11 98:7	pencil 81:18
191:10 194:6	outreaching 52:21	pallets 133:13,13	110:15 123:10	pending 180:19
195:20,21 203:4	outside 64:18 80:3	pamphlet 68:11	124:21 138:20,21	pens 188:10
opening 24:16	90:7 103:22 104:1	pan 32:18	144:7 146:4	Pentagon 199:2
58:12 121:17	140:21 213:13	paper 35:3,5 37:11	153:20 156:5	people 8:4 14:7,9,9
207:16	outweigh 161:15	54:8 77:19 78:13	165:5,11 176:11	19:10 27:6 35:9
openness 217:13	over-conditioning	81:4,4 86:3,15	176:12 181:13	40:3 44:6 65:17
operate 56:11	71:3	88:17 93:11 96:15	183:2 186:10	80:6 95:16 96:2
operation 63:14	overall 176:20	paperless 84:9,16	190:15 192:8,10	101:22 105:22
175:7	overcome 118:4	85:5,19,22 86:14	192:22 193:14	112:21 118:7
operational 87:7	overlapping 104:10	papers 19:4 22:9,11	204:18	121:15 127:16
operator 84:1	overloaded 139:9	22:15 26:1 88:12	partially 99:18	134:16,20 136:11
operators 84:2	overly 111:19 181:8	88:12,20 90:4	133:9	137:4 141:19
opinion 111:18	overseas 196:15	93:8 97:11,12	participants 81:2	142:21 155:7
122:22 123:3	overseeing 50:18	99:16 215:9	91:6,15 92:6,10	157:7,14 159:5
127:10	ownership 11:3	216:15	94:20 95:9 96:4	165:1 167:2 172:9
opportunities	oxidation 182:18,18	Paquet 1:13 2:2 4:2	215:16	176:16 180:10
211:18	182:21,22 184:3	4:6 18:9 19:1	participate 89:11	192:8 196:6
opportunity 7:8	184:20 186:9	23:20 25:6 26:8	89:17,19 92:8	200:14 202:16
19:15 35:16 57:20	oxide 156:3	27:1 35:13 41:15	94:19	207:6 212:4
80:17 100:9		42:15 47:18 49:21	participated 120:1	216:14,19 217:3
165:14 206:1	P	51:20 52:5 53:16	participating 9:1	people's 39:11
209:12 217:8	p.m 222:18	57:2 58:5,9 63:16	95:12 218:21	perceive 94:9
opposed 8:10 33:2	Pacific 19:13	65:20 68:20 69:3	participation 11:20	percent 46:8 47:1
121:17 159:12	package 67:12 72:9	76:10 78:2 80:2	49:19 91:10	47:11 52:12 56:19
opposite 157:7	72:9 73:20 74:4	82:3 84:4,7 97:16	222:14	81:21 133:7 150:6
opposition 7:20	74:10 75:14 80:22	99:9,13 107:21	particular 17:1	151:3 183:1
optimistic 119:18	81:22 91:3 103:8	108:16 110:15	18:16 19:8 39:10	percentage 83:2
option 35:8,12 37:1	103:22 104:1,11	113:16 119:11	40:4 50:4 57:8	perception 25:20
42:1,6 92:19	105:10,11,15	120:4 125:7	158:12 165:22	148:21 221:5
options 14:19 41:16	115:1 124:7	131:19 138:6	196:9 200:16	perceptions 16:21
81:13 94:4	packaged 103:9	140:4 141:7	particularly 48:6	perfect 172:10
orange 119:6	104:5	150:15 153:10	111:2	179:20 201:7,8
order 26:5 32:6	packages 33:3,4,5	154:18,20 160:21	parties 106:17,20	perform 22:3 99:6
169:21 171:22	70:8,12 74:3,6,13	161:20 163:15	partitions 4:16	206:16
174:21,22 203:4	74:18 75:11,17	164:5 165:13	partner 113:9	performance 48:4
ordered 137:13	104:5,15,16,18	166:8 167:3,5,8	202:18	59:21 69:17 79:12
organization 111:4	106:4,5 116:19,20	178:21 181:12	partnered 111:12	86:12,22 89:4
179:13	116:22 118:10,12	185:6 192:6,14	partners 43:10	91:13 97:4 123:12
orientation 91:17	packaging 69:12,16	193:20 194:4	parts 53:18 187:10	208:12
oriented 69:17	70:14,20 74:22	203:19 204:1	party 70:7 79:14	performed 22:1
original 106:14	76:14 78:6 80:10	207:14 209:7	80:18 83:3 130:6	46:7 61:4 71:12
119:15 152:1	82:10 83:2,3,12	214:22 217:9	pass 79:11 111:20	75:22
originally 59:17	83:18 107:10	218:15 221:17	112:1,5,8,11	performs 99:5
101:17 107:19	109:13 130:18	222:16	passed 67:14	period 26:9 37:18
111:5 112:7	134:5 176:19	paragraph 30:6	112:16	53:11 68:4 80:4
originated 10:1,4	177:16,17 180:13	parallel 61:10	passing 112:12	91:2 92:1 132:14
OTA 218:5	180:15,18 181:4	62:18	passive 158:5	186:13 192:10
ought 98:12,13	188:13	paramedic 112:19	path 110:4	periods 7:7
outcome 78:12	packagings 180:17	paramedics 112:20	pathogens 126:15	permission 201:19
131:14 148:11	180:20	parameters 206:21	pattern 15:17	permit 132:21

<p>136:17,18 138:13 139:17 permits 4:7 27:5 138:11 155:2 permitted 136:6 permitting 139:1 perpendicular 47:3 person 137:13 152:9 196:14 197:16 218:19 personal 112:22 122:8,22 164:8 197:12 personally 50:19 58:22 personnel 142:16 perspective 9:8 142:3 151:13 162:10 pet 79:4 petitions 130:20 petroleum 181:21 Pettit 2:21 76:13,13 77:13,22 phase 43:14,15,18 43:19 45:2 51:11 51:12 86:19,21 87:5 89:1,3 178:11 phases 43:13 86:19 PhD 143:1 phenomena 186:15 phenomenally 129:7 phenomenon 182:11 187:1 PHMSA 4:7,12 9:10 10:11 11:3 11:13 15:5 20:2 38:11 43:8 50:1,6 53:3 58:18 69:15 85:9,12 89:7 98:18 100:3,4 111:8 119:19 120:1 155:1 164:22 191:10 197:19 203:6 204:20 208:2 211:12 212:20 213:8 220:5 PHMSA's 8:3 204:15 205:4 PHMSIN 141:4 PHMSIN's 5:2 phone 173:2 phones 6:9 99:17</p>	<p>photo 31:3 photograph 32:14 photos 14:15 physical 60:2 96:14 107:4 122:20 123:2,6 142:16 145:8 pick 139:22 165:10 214:15 picked 64:1 158:12 picture 17:12 45:1 46:3 134:14 146:13 147:11 154:8 pictures 5:9 14:11 piece 16:14,17 43:7 57:20 83:9 94:22 179:21 211:1 piggyback 53:6 pilot 84:9,16 85:6 85:19 89:7,10,11 89:17 90:17 91:6 91:16,17 92:2,5 92:10,11,14 95:10 95:11,20 99:2 pilots 93:21,22 94:5 94:6,9 96:3 pinhole 43:20 44:14 44:16,16,18,22 47:4 pipeline 194:15 211:14 222:10 pipes 30:10 31:6 place 4:20,22 5:3 79:16 100:6 116:4 140:16 196:18 placed 33:7,8,8 104:17 156:14 plain 112:15 plan 120:17 140:6 191:3 210:7 217:5 217:6 plane 47:3 planned 89:10 210:22 planning 12:21 plans 89:7 196:10 plant 146:21 186:17 plates 44:12 46:18 49:14,14,14 Plato's 150:5 play 149:12 playing 218:18 please 6:10 7:19,20 17:17 20:15 24:1 24:1 25:10 27:9</p>	<p>51:19 80:5 141:9 142:20 144:4,8 146:15 156:22 169:16 171:13 172:3 176:21 194:12,12,12,19 195:1,5,21 204:1 217:19,21 218:22 219:4 pleasure 83:9 plenty 195:21 plop 77:18 plug 144:18 plugged 216:22 plus 87:14 148:12 pneumatic 188:10 podium 142:2 point 8:11 19:7,11 31:14 55:5 58:6 65:16 67:18 71:15 72:10 79:3,7 98:1 98:10 107:13 109:15 110:11 118:9,15 122:4 124:13 138:9 157:19 164:20 187:22 190:8 191:22 192:11 200:3 204:8 211:7 221:5 pointed 134:22 policemen 112:20 policies 53:6 199:4 policy 196:22 213:19 politically 160:9 Pollution 209:10 pool 91:7 92:7 165:18,19 poor 142:2 pop 145:9 popped 147:7,10 poppers 130:6 pops 144:14 145:18 population 203:14 poses 168:18 position 73:16 194:18 positions 19:21 positive 25:9 28:3,3 possession 214:10 possibilities 153:4 possibility 96:13 possible 13:7 44:1 71:16,19 77:16 93:22 94:11</p>	<p>101:10 118:19 187:6 possibly 94:7 193:15 204:14 post 23:10 47:6 99:22 100:12 posted 22:11 89:7 141:2,11,16 164:6 203:20 postulation 172:22 173:19,21 174:10 pot 140:16 156:15 potential 33:1 40:10 42:11 86:5 87:1 89:5 90:18 92:5 131:7,17 184:4,16 185:18 191:15 potentially 29:2,22 40:9,16 69:18,20 103:15 126:22 127:6 129:14 131:10 185:5 pound 118:12 175:18 185:21 pounds 33:5 134:3 134:15 200:10 pour 15:9 powder 33:6 39:2,3 119:17 power 65:16 103:18 powered 208:14 PRA 90:22 91:3 practice 10:2 117:2 117:10 135:10 171:3 187:13 practiced 166:2 practices 83:6 166:12 190:12 PRD 142:15 143:6 143:10 144:7 148:4,6 151:1,4 154:12 PRD's 142:10,18 143:1,5,13 144:9 146:7 147:10,10 148:6,10,19 149:1 149:3,5,8,12,22 149:22 154:8 pre-prepared 6:21 pre-recorded 23:18 precedent 68:6 predict 123:12 204:14 predicted 63:6 123:7</p>	<p>predicting 123:9 preference 124:3 124:12 preferred 124:9 preliminary 73:17 77:1 150:21,22 preparation 207:21 prepared 87:3 92:13 preparing 89:3 prescribed 41:17 prescription 82:16 82:20 prescriptive 39:6 106:1 111:19 119:7 present 21:21 23:15 24:21 43:4,6 103:17 182:21 183:8 211:6 213:21 presentation 7:5 21:1,4,10,11 28:9 36:2,12 38:7 42:21 47:17 49:13 58:16 69:4 84:8 85:8 94:7 107:20 108:2 109:2 114:18 125:9 131:21 142:4 154:20 167:9 179:7,10 181:15 presentations 6:17 12:15 21:3 23:10 23:22 65:21 100:1 100:13,20 141:12 presented 35:6 37:9 38:2,11 203:7 presenter 6:19 52:6 52:6 100:16 presenters 21:3 23:15 presenting 10:16 21:19 presents 182:13 202:13 President 47:21 pressed 164:7 pressure 60:17,18 61:3,3 62:1,2,3 63:7 73:14 83:16 142:5,7,8,22 143:6,8,11,17 144:13,14,16 145:2,6,8,12,18 145:19 154:12</p>
---	--	---	--	--

presumed 128:6	110:16 134:12	professionals	promises 141:18	222:4
pretty 5:6 6:18 8:18	136:2,2,12 150:10	215:20,21,21	promote 93:5	protected 102:19
27:6 41:19 60:18	152:17 153:9	professor 50:18	196:14	110:9 158:4
70:17 71:16 73:19	157:9 162:18	program 9:7,11,16	promoted 197:14	protection 111:14
107:13 108:13	174:18 175:4	9:18 10:7 11:17	promoting 19:14	112:21 137:6
137:8 151:9 158:1	190:2 197:10	13:9,10,11 15:18	promulgation	protective 112:22
158:1,2 172:12	201:6	16:6 17:20 18:2	171:3 178:13	protest 163:7
174:7 182:13	problems 7:15,22	20:2 25:13,15,18	proof 32:20 33:14	prototype 170:21
189:13 213:14	17:5 113:13	84:9,17,21 85:6	159:3 161:13	170:22,22 177:9
prevent 114:6	164:18 166:12	85:20,21 89:18,19	203:17	177:11
157:11 177:18	171:5 189:17	151:9 152:2	proof-ness 72:15	proud 11:3,4 16:3
184:1 186:7	197:21	161:22 164:13,15	proofness 74:7,19	51:21 68:20
preventing 57:18	procedure 28:15	169:18 197:17	75:9,20 76:18	prove 78:12 79:2
prevention 157:10	40:13 46:15	198:16 199:11,21	propagate 201:12	190:4
previous 19:21 23:2	152:21 170:13	215:4 220:15	201:13	proved 165:6 187:9
44:17 114:18	172:6,6	222:1,10	propagation 51:5	provide 7:4,8 25:10
119:2 124:4	procedures 80:14	programs 16:10	propane 28:21 32:8	27:11 75:4 76:7
previously 50:7	101:20,21 106:22	project 17:1 23:9	32:12,14 33:9	80:21 81:13,13
57:12 101:9	111:16 114:6,10	23:15 24:14 28:11	40:22 104:8	87:4 92:17 125:4
123:22 164:21	PROCEEDINGS	35:22 36:4 38:16	114:20 118:15,17	151:18 153:11
primarily 57:15	4:1	38:22 43:4,5,8,12	145:22 146:2,5	162:2 194:12
103:7 187:22	process 15:17 45:21	44:15 50:4,4 51:9	148:2,4 149:3,7	195:2 218:22
primary 186:1	49:10 50:12 55:21	56:5 58:6,17,20	150:5,7,9,17	219:4,18 221:11
190:8	65:19 81:22 82:1	59:2,3,4,13 60:2	151:5,9 154:14	221:11
principal 40:18,18	126:1 139:1	63:9 80:12 82:8	185:8,21 188:19	provided 56:9
63:1	152:21 184:20	85:2,18 86:11	188:22 191:8	57:16 108:21
printing 19:4	197:17 199:1	87:6 92:20 108:17	propellant 33:3	providers 95:18
prior 30:17 70:12	processes 199:3,11	109:14 111:3	proper 152:22	provides 83:15
priorities 88:14	produce 28:22	117:7 119:2,14,15	properly 137:10	204:20
164:9	38:18	122:8 125:12	151:12 187:1	providing 84:15,18
prioritized 164:13	produced 52:18	131:4 132:5	properties 123:6,12	86:1 90:12 95:8
prioritizing 198:3	producing 32:12	139:19 153:14	131:5,9	99:4 113:17
priority 17:1	212:21	155:12,13 159:14	property 122:20	151:10
164:16,18 206:5,7	product 29:11	170:20 191:6	123:2,17 131:15	provision 199:22
pristine 133:14	30:11,16 32:8	195:5,6 200:16,20	142:13 146:22,22	provoking 185:2
private 48:22	34:9 39:10,12,16	202:22 204:7	186:9	psi 60:18 62:1
proactive 133:18	49:2,3 132:11,14	207:3 218:9	proposal 111:6	public 10:17 12:5
135:3 204:21,21	137:3,14,16,22	projectiles 113:8	122:5 126:11	16:21 26:4 85:9
207:16,17	138:5 139:7,11	projection 104:19	128:11 152:1	88:22 89:10 91:10
probabilities	152:12 159:11	105:12 115:7	160:21 161:21,22	97:22 101:5 106:7
165:11	160:9 165:22	121:19	167:14,17 179:14	120:1 139:7 152:5
probability 165:2	166:4,21 189:19	projections 104:15	204:2	178:9 183:5 184:9
probably 22:19	200:9,16 201:3,4	projects 21:18,19	proposals 26:16,17	192:10 205:7
34:10 42:2 55:3	208:9	21:20,21 22:2,15	127:16	220:4,12 222:4
65:22 79:21 81:6	production 77:16	22:20,22 24:18,20	propose 52:16	published 90:9 91:1
105:22 106:19	productive 164:2	24:22 25:1,3 26:6	100:9 129:9	pull 131:22
124:2 127:15	195:2	40:19 53:19,19	157:14	pulled 48:8
128:12 130:8	productively 13:6	69:11,12 100:9	proposed 24:20,21	pulling 95:16
140:12 192:19,21	products 9:20,22	113:18 119:19	24:22 53:20	puncturization
193:7,7,8 199:13	39:13 112:5 135:7	165:10 191:7	108:17 113:18,22	62:17
205:1,11 206:17	138:3 139:21	196:8 197:18	115:12 129:8	pure 45:10
209:1,19 212:15	155:3,4 159:22	198:3,10,12 204:9	proposing 114:9	purged 45:12
probe 53:4	160:2 191:3 200:5	205:15,17 206:4	proprietary 26:15	purpose 62:6 85:10
problem 56:21	200:7,8	206:12	prospectors 96:1	87:9 88:2 143:7
63:14 65:5,7	professional 19:10	prolonged 156:8	protect 8:4 60:1	151:20 169:6
69:21 101:10	83:3	promised 141:17	155:7 220:12	179:4

<p>purposes 191:9 pursuant 1:12 pursue 53:14 57:19 120:20 pursuing 216:12 pushed 62:10 pushing 192:14 put 20:18 25:7 45:6 45:19 59:8 62:6 65:4 69:22 70:9 73:9,13,15,20 74:1 75:18 98:5 104:6 134:5 135:8 137:9 139:7 150:8 158:16 159:14 162:12 163:4,18 166:15 176:3 181:3 188:10,14 194:20 205:8 219:16 puts 194:20 putting 18:11 26:17 72:8 108:12 139:14 216:11 pyrotechnics 137:7 205:22</p> <hr/> <p style="text-align: center;">Q</p> <p>quadrants 104:17 qualification 61:12 qualified 50:15 qualify 61:8,19 quality 214:19 quantify 114:11 117:11 119:1 131:5,8 quantitative 153:20 quantities 135:1,1 quarter 54:17 137:18 156:18 quarters 54:12 156:17 question 16:20 18:1 25:18 29:4 36:20 40:20 48:20 49:7 50:14 51:1 54:7 55:11 64:20 67:7 67:10,21 68:2,13 80:11,12 93:19 110:19 120:10 126:21 127:5 138:6,19 159:6 162:20 164:3,7 182:8 184:18 194:19,20 200:3 201:15 202:21</p>	<p>203:21 208:8,15 209:13 210:5 questions 11:14 13:14 15:2,13 21:5,22 23:14 34:22 36:6 44:15 47:19,22 48:20 49:21 54:6 58:5 63:15 67:3 76:11 76:12,22 90:12,20 92:22 128:12,13 131:18 135:19 141:3 150:14 178:22 183:12 215:22 216:2 220:19 221:4 quick 31:11 67:2 77:13 183:5 221:22 quickly 9:3 10:9 34:18 37:6 66:8 156:1 quite 31:16 41:7 57:5 64:6 148:1 175:3 202:20 quoted 218:7</p> <hr/> <p style="text-align: center;">R</p> <p>R 7:21 R&D 9:7,11,18 10:7,12 11:12,12 11:13,17,21 12:3 15:2,18 16:2,6,19 17:7,8 18:1,1 19:18 22:6,9,11 22:11 100:2,3,10 141:14 197:22 202:3,4 204:19 210:8 220:22 221:1 222:1,6,10 R&D.gov 100:4 radar 171:21 radiance 29:17 radiant 176:13 radiometers 33:11 115:18 118:1,20 radius 176:12 rail 13:22 14:2,2,18 147:21 185:9,13 185:17,20 186:11 186:11 190:3,12 192:21 193:2,16 200:17,19 201:12 201:12 209:14,17 214:16 215:22 216:2</p>	<p>railroads 9:21 14:6 raise 45:19 175:1,3 raised 201:11 raising 142:10 rally 5:5 ran 9:16 random 127:2 Raney 3:2 84:10,11 94:12 96:7,17 98:22 range 45:6 84:3 175:8 rapid 126:19 rapidly 116:5 rapidness 126:21 rate 32:5 43:17 112:9 rates 123:5 182:22 190:21 rating 111:21 112:2 112:4,13 ratio 61:2 177:11 rational 220:1 re-base 102:13 re-closable 145:14 145:17 re-conditional 77:17 re-conditioners 76:20 re-conditioning 75:7 re-manufacturing 75:7,8,11,13 re-qualification 68:12 re-qualify 67:4 re-use 75:12 re-using 75:10 reach 61:13 71:11 144:16 reached 48:21 reaches 145:18 reaching 59:16 127:16 react 34:9 127:3 204:16 reacted 34:16 reaction 29:20 34:11 142:10 148:11 156:5,15 182:20 reactions 29:14 38:19 108:7 reactive 204:18 reacts 30:16</p>	<p>read 22:15,17,19 26:8 54:8 95:13 105:9 124:20 172:5 202:11 213:4 readily 131:17 ready 38:2 129:17 reaffirming 109:9 real 9:12 12:9,10 31:11 33:19 77:13 152:17 179:20 204:12 realize 184:5,16 185:3 196:21 really 5:6 14:2 15:15 31:4,10 34:20 36:15,22 41:7 73:16,18 76:2,15 77:21 79:4,10,22 81:17 82:18,20 83:19,21 84:3 86:18 101:5 101:9 102:11,12 102:15 103:4 105:2 106:16 107:13 108:14 109:1,2,10 110:2 110:11 113:17 116:13 117:7 118:16 119:3 120:18,22 121:3 126:20 127:15,22 128:1 131:2,4,8,8 140:7 148:21,21 149:7 151:9 153:20 158:4 160:20 164:11 177:2 180:4,9 184:22 185:1,13 186:16 190:4 191:9,10,14,14,22 192:2 193:10 196:17 199:20 204:3 205:22 206:5,7,15 207:3 207:7 210:6 211:14 212:5,6 213:4 216:6 218:17 220:9 221:9,10,12,16 reason 55:15 56:6 81:19,20 83:20 136:6 146:8 148:5 168:18 170:5 183:2 194:21 219:20 220:2</p>	<p>221:1 reasonable 106:9 127:13 reasons 36:22 37:16 144:2 161:11 recall 151:15 recalled 190:1 receive 20:21 24:17 91:4 169:12 176:14 received 89:16 91:8 reclose 145:20 recognition 19:15 191:6 recognize 83:18 130:5,13 131:11 220:20 recognized 188:8 220:20 recommend 80:19 166:13 recommendation 92:17 recommendations 75:4 76:7 87:3 recommended 45:16 183:10 190:11 recommending 184:7 reconditioning 74:17 75:11,13 76:17 reconfigured 119:19 record 11:10,11 96:6 117:17 recorded 31:16 recording 212:18 recreated 199:1 recruitment 74:15 red 189:17,18 redefine 101:10 reduce 47:7,7 53:3 155:11,16 158:9 203:16 reduced 159:2 203:14 reduction 46:2 52:20 155:21 198:21 Refaat 3:9 141:20 152:8 refer 85:7 218:8 referred 28:13 187:2</p>
---	--	--	---	--

<p>referring 60:5 123:21 refilled 186:18 refilling 146:9 reflect 76:9 103:18 reflected 36:9 37:20 115:5 regard 93:19 112:7 151:15 180:22 regarding 21:1,3,8 39:19 50:14 70:11 74:19 177:11 182:1 regardless 182:18 regards 86:1,8 89:14 91:11 96:18 97:8 regions 91:19 register 20:20 regs 28:19 187:12 regular 31:17 regularly 51:1 regulated 136:9 207:10 regulation 86:16 92:18 215:6,7 regulations 10:21 10:22 11:1,6,9,9 54:3 75:4 76:8 105:7,8 111:18 136:15,19 143:14 143:20 170:22 171:4 182:5 regulator 164:21 204:19 regulatory 90:6 216:12 reinforced 60:12 reinventing 40:6 relate 36:1 88:15 113:8 related 51:6,7 57:13 88:15 114:4 118:22 150:7 151:3,4 185:13 196:10 202:5 220:4 relates 58:4 104:7 relation 208:18 relations 193:14 relative 56:10 134:8 209:16 relatively 32:16 release 142:8,15 143:11 released 24:14</p>	<p>156:7,7 releasing 156:16 relevant 64:3 83:10 reliably 119:9 relief 142:6,7,8,22 143:17 relieve 46:10 relieved 46:9 relieves 45:20 relieving 45:18 relooking 109:9 relying 95:6 remain 205:12 remains 187:20 remarks 7:18 remedy 135:7 remember 6:10 35:17 79:7 108:16 176:5 remembering 155:6 remind 8:3 35:1 remote 91:21 remotely 175:22 rendering 213:19 reopened 147:20 repeat 114:17 161:8 rephrase 42:2 replicate 104:12 report 22:16,20 82:16 87:2 92:13 92:13 94:2 150:20 150:21 153:20 154:7 166:20 170:8,8 189:10 216:11 218:6 reporter 6:12,13 reporting 170:10 reports 54:18 121:5 152:9 153:19 188:20 192:9 represent 126:13 127:22 131:14 134:8 representation 89:21 211:13 representative 88:8 represented 43:8 representing 15:14 82:9 87:15 89:20 represents 134:13 159:10 reproducibly 117:17 119:4,9 qualification 67:20 requested 193:21</p>	<p>require 17:2 143:14 143:20 152:22 155:22 required 61:8,18 75:14 86:16 97:11 170:10,10 requirement 68:9 97:4 172:17 requirements 44:9 44:11 53:1,5 82:1 85:17 86:3,18 87:8,10 91:9,14 91:22 97:7,14 112:14 113:7 169:21 171:7 177:12 requires 172:20,21 202:12 research 1:1,11 18:13 19:20 22:6 25:13,22 26:2 28:11 38:15,17 42:11 43:3 50:10 52:16 53:4,18 58:15 67:3 69:10 69:11 73:17 74:16 74:20,22 76:9 77:11 78:13,14 79:10 80:22 81:13 82:19 83:4 85:16 102:21 106:16 111:3 113:6,22 114:9 115:12 122:9 124:16 125:12 126:10 127:5,17 128:11 151:7 152:4 161:17 163:13,18 164:9,12 167:15 169:6,18 172:2,13 175:17 179:4,19 180:1,4,12,22 181:9 183:13 187:22 198:9 206:13 207:16,19 207:20 208:3,16 209:10,12,16 210:2,3 211:1,16 212:9,16 213:2,22 215:5,6,17 216:10 216:16 217:3 218:9 219:3 222:18 reservations 113:4 residual 46:6,7 resins 60:21</p>	<p>resolved 216:20 resources 15:8,15 16:11 66:17 78:12 99:6 121:21,22 122:3 150:3 159:13 165:9 respect 26:15,18 82:22 176:5,9 187:5 212:4 221:9 respects 95:10 respond 123:20 149:21 151:12,13 163:15 195:16 200:2 204:20 responded 12:18 responder 98:13 106:21 responders 87:18 88:18 95:6,18 96:1 98:4 99:7 101:1,13,18 102:14 107:5 109:6 146:18 149:20 151:8,12 156:19 197:7,8 201:17 205:7 responding 102:14 response 86:9 94:19 95:5,18 101:19,21 102:18 105:5,14 106:2,8,12 107:7 107:17,18 109:21 110:3 111:3,16 195:17 responses 90:10 195:14 responsibility 216:8 responsible 13:12 43:7 responsive 204:14 rest 194:5 restaurants 5:7 140:13,15 restrictions 130:18 130:19 restrooms 6:1,3 52:2 result 11:4 44:13 63:5 64:2 136:20 146:14 results 39:8 46:22 57:8 73:19 74:9 87:3 88:5 160:17 212:19 216:10 222:13 Retailers 48:19</p>	<p>retesting 83:10 retire 217:4 retired 54:8 retirements 197:13 retraining 187:15 Reusable 76:14 reuse 74:17 75:7 77:17 reused 75:18 revalidating 202:7 revealed 71:5 review 91:4 125:22 130:22 188:1 190:9 216:15 217:18 reviewed 130:15 reviewers 43:12 revision 102:3 105:18 revisit 187:4 Richard 2:7,14,18 2:19 3:7,17 48:18 63:17 65:11 78:3 78:3 93:1,2 95:13 125:8 128:21 153:12 164:21 179:1,18 215:2 Richards 143:1 Rick 217:9 rid 136:12 139:2,16 139:21 ridiculous 93:12 right 4:19 6:2,3,5 7:1,4 13:1 17:11 17:12 19:13 22:7 22:7,7,11,11 26:9 27:1,19,20 29:22 35:13 37:5 47:18 51:20 52:4,5 56:14 58:5,9 63:5 63:16 68:20 69:4 69:5 70:10 76:12 76:13,21,22 77:22 81:8 82:12 84:7 90:8 93:5 97:16 99:8,13 100:15 108:20 113:19,21 125:7,8 131:19,20 140:4,9,20 141:7 143:13 147:12 150:15 154:18 155:7,12,16 156:11 158:2,10 159:2 161:4,6 163:17 167:9,15 169:6,17 172:7,11</p>
---	--	--	--	--

172:19 173:13	101:22 196:6	86:2,12 92:15	217:11,17 221:21	79:10 83:4 99:17
176:12 177:5,20	204:22	93:5 97:22 108:1	science 20:3 100:16	101:10,11 106:10
178:19 179:7	root 74:20,22 75:2	110:10 123:7	196:22	106:20 107:6
181:2,18 193:20	150:18	134:21 136:20	Sciences 27:21	109:5 110:16
194:4 195:9,13	roughly 32:2 33:5	137:8 142:5,7,18	scientist 101:4	111:7 113:7
199:4 202:13	69:14 183:14	151:8 152:6 155:2	scientists 180:1	116:15,20 117:5
204:22 205:5	route 74:16	162:4 168:15	207:22 208:4	118:9,11 121:5
208:19 209:20	routine 198:5	176:20 178:3	SCOE 35:3	126:15 127:16
211:7 214:22	rubber 156:12	191:3 194:16	scope 101:13 138:7	130:9 135:9 137:4
218:15 221:17	158:10,18	201:16 208:6	138:21 155:13	141:10 142:1,17
risk 15:6,10,11,13	rule 150:6	221:3,3	160:15 161:2,5	144:2,7 146:4,13
15:14,19,21 16:9	rule-making 210:4	sake 13:10	162:19 207:4	147:9,12 148:21
16:11,14 100:17	rules 4:13 94:5	sakes 54:22	screen 102:5 176:1	149:11,13 151:5
100:22 101:12,15	166:11 194:5	sample 45:3 202:12	182:6	154:14 157:4
101:18 107:5,17	195:12 218:18	202:12 212:13	screens 33:21 102:7	158:14,21 161:12
109:6 110:6	rumors 193:10	samples 45:4,4,6	102:9 104:17	164:19 168:10
123:10 126:12,13	run 6:22 7:11 9:11	65:2 66:4,5 183:7	113:11 114:22	170:1 174:4 175:9
127:21,22 131:14	17:20 27:15 28:5	sane 136:6	seam 46:16	176:1 177:1
134:8,13 155:15	34:18 40:3 42:4	Santis 3:6 124:15	search 100:14	181:16,19 186:16
155:16,21 160:4	116:14 169:4	124:15 207:15	190:9	189:3 190:10,10
163:11,12,13,22	220:22	Sarah 3:13 162:22	seat 145:18	192:4 197:20
165:17,20,20	running 9:17 16:5	satisfy 91:9	second 54:11 65:7	209:5 214:17
167:22 185:4	30:10 33:1	save 66:21 166:18	68:2 82:15 86:21	215:8 216:19
198:13,14 200:15	runway 169:4	207:12	89:3 118:11	seeing 39:9 40:9
201:8 203:12,13	177:19 180:18	saved 160:1	144:17 147:2	66:14 105:6
203:14,16 209:16	rupture 143:10	saving 160:5	168:18 170:1	110:10
210:12	144:12 145:5	savings 29:22 34:17	179:3 181:13,22	seek 155:19 210:18
risks 8:4 10:18 26:3	ruptured 145:9	saw 44:17 45:1,13	196:13,19 217:12	seeking 89:11
155:7,10,11 159:2	154:5	45:14,17 46:7	220:7	160:18
163:19 202:13	ruptures 43:21	49:1 95:14 109:3	secondly 25:22 48:3	seen 10:6 14:11,14
204:21 211:6	rust 44:20 189:16	151:16 154:3	63:12 160:15	18:15 32:17 81:15
river 5:6	189:17	156:15 167:11	seconds 42:18	89:6 113:11 117:2
road 53:13 57:14	Ryan 1:13 2:2 4:6	179:17 197:20	secrecy 214:7	130:10 161:15
97:19 98:1,16	18:14 22:4,18	saying 7:11 35:4	secret 13:18	185:11,11 212:17
140:22 158:11	25:12 28:1,10	67:7 78:14,16	secretary 19:16	217:2
185:10,14	38:4 82:5 84:13	82:16 95:19 97:5	87:4	segregate 149:14
roads 208:10	119:22	109:11,18 110:19	section 28:19 85:18	seized 132:11,21
roadways 56:12	Ryan's 197:20	117:7 123:3	143:15 161:21	select 49:9 91:6
Roberts 189:10		163:12,21 165:1,4	182:5	198:11 205:17,18
robustly 12:2	S	166:17 174:19	secured 153:18	selected 91:7 92:6
rockets 136:8	S.E 1:7	187:7 189:5	security 5:10,13	143:17
role 57:18 149:11	SI.7 143:18	says 4:17 39:7	20:1 86:12 92:15	selection 70:13
roll 76:19	SAAMI 38:6	54:11,16 105:20	214:11	93:20
rolling 10:4	safe 59:15 85:5	106:8 116:9 117:3	see 5:7,8 6:17 7:5	self-certifiers 70:8
rollover 52:7,11,17	102:14 110:3	scale 33:20 92:20	12:15 15:13 16:5	80:18
53:10,10 55:13,17	135:8 136:5 169:8	103:3 142:15	16:17 22:8 25:21	self-contained 59:6
66:11	201:10 208:8	175:9	34:10 35:14 38:21	self-destructs
rollovers 52:11,15	safely 15:1 140:2	scaling 114:5	39:13 40:3,8	212:14
53:3,7 55:12	169:11	scans 170:18	42:18 44:12 46:1	sell 49:2 212:10
56:20 57:5,9,19	safer 93:16	scenario 30:15	46:5 47:1 53:5,16	sells 95:15
66:16 163:19	safest 159:22	104:13	54:1 59:15,22	send 7:7 100:7
Romania 157:4	safety 4:7,11,11 8:1	scenarios 39:3	62:7 64:2 65:4,6	192:9
159:19	8:20 11:10,11	119:17 133:11	65:21 67:6 68:15	senior 19:22
room 4:15,19 16:18	12:6 13:13,13	151:11,14	71:16 72:17 73:8	sense 26:2 93:21
27:6 36:8 44:6	14:21 26:3 43:4	scent 184:11	73:16 74:8,21	123:16 169:7
78:6 84:20 87:22	61:1 63:11 69:19	Schick 3:18 217:11	75:15 76:6 77:9	193:12,14 205:18

207:18 208:6 210:17 sensitive 7:21 184:13 sent 66:19,20 121:2 separate 48:13 116:10,20 117:5 122:18 124:6,7 172:21 separately 123:17 September 36:18 87:21 series 103:2,7 114:1 126:5 202:8,9 serious 57:6 147:18 184:5 seriously 93:4 serve 45:9,13 service 44:7 48:3 60:17,19 61:9 65:9 67:9 68:8 186:22 Services 78:4 93:2 serving 19:21 session 35:7 198:6 216:6 set 4:13 6:18 10:21 11:6 16:7 18:10 19:10 28:14,22 29:1 30:7 39:21 40:3,13 44:22 61:21 62:20 63:4 63:4 68:3,5 71:8 110:6 114:12,19 119:7 121:11,15 123:22 124:10 128:18 144:13 145:18 164:8 194:4 195:1 217:5 220:14 setting 7:1 35:10 195:11,12 settle 80:14 settling 147:4 setup 31:3 37:17 40:15 setups 41:16 seven 66:20,21 127:4 146:20 157:5 183:6 212:1 seventy 127:2,4 Seventy-three 89:18 seventy-two 127:3 severe 14:8 Shafkey 3:9 141:20	141:22 150:20 151:19 152:19 154:1,19 shaker 173:6 shale 48:5,7,9 shape 113:18 share 9:3 10:9 12:20 40:15 122:15 161:9 189:10 sharing 217:13 sheet 141:8 sheets 141:9 shelf 59:16 217:2 shell 46:5 47:2 60:21 126:18 134:4 shells 125:15,17 126:2,5,7,9,12,17 126:17,18,22 127:1,2,3,4,9,10 127:11,22 128:18 129:4,12 133:7,7 133:10 135:21 206:8,15 shelter 4:20,22 5:3 Sheriton 189:7,9 shield 158:3 shielding 157:13 158:1,4 162:6 ship 14:18 shipment 10:13,14 14:2 209:17 shipments 12:12 85:5 94:21 177:15 shipped 130:17 shippers 10:17 86:10 87:19 88:20 94:14 95:3,17,22 shipping 14:17 86:14,15 93:8,10 96:15 97:11,12 ships 108:4 168:12 shock 55:14,19 172:8,11,18 173:4 174:5 179:10 shoe 135:12 shoot 129:7 133:6 139:9,11 shop 6:5,7 10:1 52:3 65:1 short 27:10 28:8 41:14 82:9,13 169:2,3 177:6 209:18,19 shortcut 115:21	shorter 53:21 205:16 shortly 65:22 shout 222:5 show 17:15 32:22 65:17 99:19 130:4 130:5 133:6 173:3 182:22 showed 145:15 showing 31:10 shown 71:10 73:18 144:10 shows 32:15 33:15 133:5,8 144:12 shut 29:9,13 30:17 32:9 34:7 220:8 side 9:13 10:22 12:8 12:9,10,10 33:1 33:15,16,18 34:2 40:4 90:1 95:4 140:10 186:13 210:20 211:14,17 212:5 220:1 222:10 sidebar 31:11 sign 141:8,9,9 significant 82:9 110:10 124:8 199:10 significantly 86:8 105:13 109:22 155:16 silence 6:10,11 silent 128:4,5,9 similar 70:1 87:12 106:3 123:21 129:3 177:13 181:4 198:17 208:13 similarly 127:3 Simmons 2:15 43:8 50:1,1 56:19 57:4 simple 78:13 simplifies 8:15 simply 41:2,3 61:2 61:5 62:4 76:1 152:20 153:4,7 173:10 simulating 122:19 simulations 94:18 94:19,20 95:7 simultaneous 70:16 74:3 126:19 simultaneously 96:9 126:22 single 17:6 33:7	103:8 124:6 134:4 singles 158:10 sir 68:18 181:18 sit 82:4 132:3,13 186:12 217:2 site 14:15 74:15 200:12 201:12 sites 40:8 129:1 sitting 16:17 133:2 135:16 141:19 193:15 207:7 situation 14:3 15:4 74:5 76:2 133:19 135:13 136:1 138:4 149:21 205:13 situations 116:18 133:22 134:8 135:11,14 149:12 six 112:14 117:19 198:6 sixty 22:16 63:21 64:8 89:8,15 90:11,14 sixty-day 90:15 size 64:14 126:3,7 143:17 168:4,7 171:20 180:8 sizes 87:17 127:15 129:3 sizing 50:21 skill 16:7 skilled 19:9 143:4 sky 128:19 slew 140:21 slide 22:5,8 44:17 46:1 71:17 106:11 106:13 114:2 115:1,13 117:22 130:4 134:14 142:19 146:14 155:5 156:9,22 157:15 158:8,19 167:13 179:1,3 182:16 slightly 79:18 slow 167:20 184:3 184:22 186:7 slower 41:5 small 9:8,10 10:11 10:12 17:20 103:3 130:8,10 135:1 142:11 172:19 174:1,1 176:3 206:11 smaller 142:15	149:15 smell 184:10 smelling 184:15 Smith 2:11 40:17 40:17 122:7,7 smoke 34:4,5,12 smokeless 39:2,3 119:17 smokes 130:8 smoking 148:8 snacks 6:8 snakes 130:7 snap 199:10 snaps 130:7 snapshot 183:15 sniff 183:21 193:4 soak 134:18 139:12 soccer 157:7 societal 161:18 society 15:11 soda 6:7 softer 174:12 software 95:14,15 96:5 98:17 solely 33:20 solicit 106:17 solid 131:15 solution 119:3 135:13 solutions 7:22 101:11 solve 11:15 201:6 solvent 199:8,8 somebody 62:21 137:20,21 138:12 141:1 148:8 189:8 193:13 221:19 somewhat 121:1 soon 96:12 121:7 124:3 192:11 205:10 sorry 22:7 31:8 35:1 58:9 105:7 113:2 171:10 173:1,13,22 175:5 200:6 204:12 sort 40:20 57:14 127:20 129:13 150:1 152:3 161:14,14 186:19 187:15 198:6 sound 205:1 sounds 36:8 80:2 109:10 114:3 source 152:13 153:8 170:15
--	--	--	--	---

South 189:7	spoken 210:12	124:3,7 141:2,17	211:20,20 212:14	studies 49:1 187:3
space 45:5 158:18	Sporting 38:5	142:4 156:14	stick 101:8 217:6	189:3 191:1,18
168:14 171:18	110:22	195:22 215:11	sticks 137:18	study 36:14 37:21
span 163:3	spot 190:9	216:10 218:16	stimulated 112:7	43:13 44:4,10
sparklers 130:9,10	spread 122:3 148:9	started 28:11 53:9	stock 10:4	45:2 52:7,11,13
130:11	spring 85:11 145:17	58:17 61:22 77:2	stone 71:8	55:7 57:7,8,12,17
speak 119:15	squad 137:20	147:3,5,7 148:9	stop 7:1,11 29:20	65:13,15 67:13
149:17 180:15	square 30:8 31:2,5	151:1 154:3	178:17 186:6	86:11 101:12
205:4	squared 104:22	188:21 196:2	stopped 149:5	102:16 113:7
speaker 2:1 141:20	115:10	221:17	stopping 185:5	138:10 144:2
SPEAKER'S 3:1	stability 56:8,17	starting 42:8 141:2	stops 93:7	149:13 171:11
speakers 8:2 213:13	57:13,22	188:20 190:8	storage 132:13,13	178:1,11,12 182:8
speaking 9:2 149:6	stack 32:19 70:17	starts 41:14 63:1	146:6,9 149:14	213:3
speaks 166:18	74:7 203:15	93:6 157:18	153:17,17 171:17	studying 113:6
spearheaded 111:4	staff 12:17 14:21	state 24:2 43:9	185:19 190:12	stuff 8:16 26:11
special 52:7 138:13	16:4,8,15 17:22	50:17 86:7 132:21	store 136:16	36:19 74:15 97:21
139:17 164:13	18:21 19:3,8 98:9	136:4 176:18	stored 135:16	108:12 120:8
217:14	98:20 120:3	182:19 190:17,19	story 218:12	138:16 200:10
specific 17:13 18:5	142:16 180:1	198:15 213:16	straight 56:7,9,14	213:22 217:2
37:2 79:6 81:20	196:9 217:14	stated 49:12	56:20 62:20 63:15	218:8 219:16
90:12,20 97:6	221:14	statement 54:9	67:16	stuns 137:3
105:3 109:19	staffer 17:20,21	72:20 101:8	strain 62:15	stupid 166:9,10
119:17 128:13	stage 153:5	106:14 109:16	strategic 205:17	style 40:4 42:1
165:15 171:9	stairs 140:9,10	123:22 124:4	strategies 133:20	subcommittee 35:7
172:1 173:15	stake 17:9 86:6,20	statements 101:3	155:15 158:21	37:10
182:6 183:5	87:7,15,17 89:2,9	states 58:21 60:6	159:1 203:3,5,6,8	subject 58:16 82:12
203:15 214:18,19	89:20 91:19 93:3	63:3 117:20 138:9	203:16	108:9 182:17
specifically 10:5	151:21 153:1,2	143:15,22 159:11	strategy 203:4,10	subjective 105:6
13:22 39:1,5,7	155:19,21 159:4,4	159:21	203:15	112:14
49:4 70:12 72:18	197:6,8 198:22	static 70:15	stratification	subjectively 112:18
73:5,10 74:19	204:22 205:6	stating 76:1	186:14,19	subjectivity 105:18
101:17 104:14	206:3	station 168:14	stratosphere	submit 26:1 125:22
114:5,8 115:11	stand 6:21 33:9	171:18	202:20	179:15 216:14
128:13	112:22 159:9	stations 58:21	straw 28:9	submitted 26:4
specification 69:16	standard 79:14,18	statistic 151:6	strayed 107:16	120:12
specifications 84:3	125:20,20,21	status 62:1 130:14	street 75:18	submitting 26:16
102:4	126:8 128:8	stay 64:2 108:9	stress 43:16,22 44:3	subsequent 41:14
specifics 77:4	129:21 130:22	173:12	45:6,18 46:2,6,8,9	146:11
103:11 169:8,22	131:12 133:21,21	staying 140:6	46:10 47:5 62:16	substance 107:11
specify 73:13	134:22 135:4	steady 31:1	62:16 217:1	122:20 123:7
specimens 44:4	153:16	steel 30:9 59:9	stresses 47:7	substances 105:10
45:17	standardize 180:5	182:17 184:19,21	stressor 63:4	107:10
speculation 193:12	standards 83:14	185:18,18 189:11	strict 103:21	substitution 199:8
speed 31:17 53:13	standing 19:9 79:7	189:12,13 193:14	strictly 112:4	Subway 140:14,17
118:8 167:18	113:2 142:16	steels 47:15	190:12	succeed 100:15
speeding 184:20	158:3	step 35:2 68:16	stringent 112:11	success 218:12
Spence 101:3 196:9	standpoint 193:17	81:3 91:5 113:21	strong 151:9	successful 9:17,18
spend 12:19,21,22	stands 60:11 85:3	steps 14:5 15:7 57:6	strongly 201:18	10:7 199:22
79:19 104:4 156:5	187:14	85:1	structure 21:11	218:13
163:12 164:12	staple 99:22 197:5	stern 201:16	59:12	successfully 83:2
193:9	staring 5:4	Steve 3:14 152:6,7	struggled 161:11	sudden 184:6
spent 108:3 180:5	start 4:11 8:2 27:19	154:4 167:9 179:6	struggling 159:12	Sue 80:9
spill 157:17	27:20 52:2 53:20	181:13 188:18	stuck 119:2	suffer 14:7
spirometer 176:2,3	65:17 101:15	STEVEN 3:11	students 46:13 49:8	sufficiently 30:21
spite 14:3 219:22	105:6 116:18	Stevenson 3:3 96:8	50:5,15,16,19	184:1
spoke 45:2	117:18,20 121:17	96:8 161:7,7	studied 149:11	sugar 98:17

suggest 54:21 78:18 108:2 118:7 216:9	142:9	56:1 69:10 77:22 80:6 104:7 113:12 125:14,14,16 151:7 159:19 167:12 180:11 192:4 193:3 203:2 209:3 214:3	technical 14:21 19:22 37:16 38:9 40:20 112:13 113:14 137:7 210:9,20	28:22 29:5 30:11 31:3,5,10,15,16 32:17,21,22 33:8 33:12,13,17 35:8 36:13 37:13 38:10 38:22 39:1,17 40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
suggesting 120:12	surrounding 29:17	talked 34:3 79:16 114:18,20 202:8 207:18 222:6	technique 45:22 50:22 59:22 63:1	40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
suggestion 20:13 21:15,16 163:6	survey 44:1 46:12 53:8 102:16 106:20 107:3,5 109:20	talking 23:16 37:19 53:20 56:16 60:15 63:19 98:15 100:17 104:4 118:17 125:11 160:10 179:10 207:16	technological 87:8	38:22 39:1,17 40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
suggestions 26:1 27:9 51:17,18 198:1	Susan 2:22 83:18	talks 101:2 105:11 115:8	technologies 183:18	38:22 39:1,17 40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
suitable 72:20,22 76:1,3	suspect 76:10	Tanika 19:5	technology 85:17 97:6 114:10,16 118:4 180:21 213:20	40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
suited 91:12	sustain 29:5 31:1,14 32:6 37:17	tank 43:4 45:10 46:9,12,22 47:4 47:22 48:15 52:7 52:11 56:4,20 57:4,18 58:1 66:10,16,20 163:19 186:17 189:16 190:1	teleconference 198:7	40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
suitable 72:20,22 76:1,3	sustained 31:8,9	tanks 30:22 42:21 43:16,21 44:2,7 44:11 46:17,18,18 47:13,16 48:2,5 49:1,9,9,10,13 52:13 56:14 148:4 182:17 183:19 185:19 186:21,21 189:11,12,13 190:13 193:15 208:10	tell 5:2 7:1 9:14 15:4 19:6 25:7,8 49:6 59:12 64:18 93:13 109:10 137:21 139:22 154:22 159:20 187:6 189:10,20 194:10 201:14 204:6 218:14	40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
suited 91:12	sweat 132:3	tape 79:9,10,11,14 79:17,20 80:3,6,8 80:11 82:15	telling 36:18	40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
sulfur 189:21,21	sweeping 138:16	tapped 207:10	tells 41:21 143:1	40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
summarize 92:14	sympathetic 80:22	targeted 221:3	temperature 29:6 30:22 31:8,9,18 41:3,4,7 45:20 71:1,4 123:5 143:7,8 144:19,20 144:22 145:1,6,7 175:8	40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
summarized 88:11	symptomatic 82:15	Tarr 3:7 125:8,10 128:17 129:6,17 131:22 132:2 140:3	ten 6:19,20 35:15 90:2 93:6 116:20 126:2,22 129:22 141:2 146:20 148:16 172:4	40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
summary 34:1 84:15,21 92:21 183:6	system 69:16 85:13 87:13 88:3 96:19 96:21 97:1 119:17 126:4 127:19 128:4,7 135:8 176:18 211:7	task 167:15 220:17	tend 19:10 167:18 220:1	40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
summer 35:7	systems 55:19 86:1 86:13,22 87:2,9 88:15 90:3 91:13 92:17,19 97:3 99:6	taskmaster 218:19	terms 19:14 86:8 88:19 89:1 90:5 95:1,9 97:7 105:6 115:9 133:12 169:1,17 171:9,15 172:17,17,18 177:3,17 178:2 196:16 198:3 199:2,12 204:15 208:2	40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
super 158:10	T	tech 43:9 158:2 196:14	term 132:8	40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
superb 157:18	table 36:10,11 37:19 58:7 96:1 183:2 205:10	tear 139:12	termed 183:8	40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
superiority 79:21	tables 141:9	tear 139:12	terminals 45:16	40:4,8,15,22 42:1 42:4 49:11 62:4 64:13 70:8,12,14 70:16,21 71:18 72:11,16,17,18 73:14,17 74:4,11 75:21,22 76:6,18 77:17 78:9,10,17 78:22 79:12,19 81:7,8,17,20 82:2 82:16 83:5 84:1,1 89:8,10,11 90:17 91:6,16,18 92:2 92:10,11,14 94:15 95:10 99:2 102:3 103:1,2,7,8,12,15 103:16,16 104:3 105:4,19 106:10 107:4 108:6 109:9 112:1 113:12 114:1,2,11,19 116:14 117:19,21 118:17 119:16 120:14 121:6 123:15 124:1,6,10 124:19,21 138:18 139:3 169:21 172:5,6,8,11,18 173:5,7,8,17 174:5 176:11 177:4 179:11 183:21 190:21 193:3,4,5 197:2 202:9,11,14,17
support 7:19 19:3 38:17 39:9 83:7 90:18 97:13 110:20 19				

74:9,9,19 75:9,10 75:20 77:5 80:22 81:12,22 82:1 83:1,11 84:3 86:21 89:4 91:13 99:2,5 115:22 116:9 119:6 122:10 123:1 169:19 190:21 206:19 208:17 testings 169:20 tests 31:12 33:1 34:19,21 62:6 70:16 72:15 74:8 76:16 77:3 78:6 78:15,19,21 79:21 91:18,20 92:5 94:17 95:11 103:4 109:9 119:8,16 120:9 122:10,13 122:16 172:1,9,9 172:10 202:7 206:17 Texas 147:2,14 160:16,20 166:2 166:13 168:14 200:4,4 201:11,22 thank 4:5 8:21 9:1 18:2,7,9,14,21 19:5 20:10 27:22 38:4,7 39:14 41:11 42:15 48:17 50:11 53:15 55:8 56:2 58:7,8,22 64:19 65:10,12 66:22 68:2,18 69:2,3 80:9 82:5,7 83:8,17 84:4,6 88:1 97:16 99:9,9 100:17 113:15,16 113:19 119:11,20 120:4,6 123:19 124:13 125:6 140:3 141:4 150:13 154:17,19 159:6 166:17 167:3,7 178:20,21 179:6 181:13,18 185:6 191:15 192:6 195:10,18 196:3 199:16 204:12 207:15 209:7,11 211:19 217:7,8,9 218:15 219:11 221:13,13 222:16	thankful 206:2 thankfully 8:14 thanking 19:1 thanks 28:2,10 35:18 39:15 66:7 75:6 99:21 138:5 221:14,21 Thanksgiving 90:9 theme 123:21 theory 32:3 thermal 29:17 31:7 33:10 34:13 104:20 105:1,12 114:7,9,11,13,14 115:4,4,14,15,17 117:8,15 118:14 118:19,21 119:4 119:10 121:4,4,6 121:14 122:2 124:20 180:18 thermos 103:3 thin 122:3 thing 38:14 71:16 71:19 79:4 94:17 99:1 108:5 113:11 120:11 122:2 145:9,10 149:19 151:6 160:4 187:16 190:5 196:4,13,19 197:3 202:5 203:17 205:20 207:1 210:21 214:3,13 things 6:8 7:18 8:15 20:14 36:21 40:12 42:5 57:12,14 70:2 71:5,9 78:19 80:1 99:14,21,22 101:5 109:19 110:1 120:13 121:19 122:4 124:17 136:8 141:8 142:3,13 148:17 153:2,7,15 156:1 157:19 158:9 159:9 160:13 164:17 166:5 175:11,13 175:22 176:10 178:4,9 181:1,6 182:16 190:13 191:20 196:11 198:14,17 199:5 200:6,14 202:4 204:14,17 205:2 207:11 208:1	210:9 211:5,9,11 212:18 213:20 214:11 215:18 216:8,13 218:3 220:3 think 4:3 8:7 10:1 10:14 17:6,14,17 21:12,16,17 23:3 23:5 26:14,20,21 28:4 36:18 38:8 38:12,17 40:7 42:7,12 48:21 55:4,7,9 66:21 72:2 73:21 78:5 78:11 79:22 80:17 81:17,20 82:10,14 82:15 83:19 94:4 95:21 105:21 109:15 112:18 117:14 121:3,20 124:18 127:9,12 134:9 135:22 138:2 139:4,6,17 139:18 144:22 149:4 153:14 154:6 155:22 159:16,17 160:12 160:15 162:1,6,13 162:19,20 165:3 165:10,13,18,20 173:19 174:8 178:13 179:9 180:4,4,10 181:8 184:15 185:8,8,15 185:17 186:4 187:6,9,21 189:9 190:2,4,7 191:5 191:16 192:7,21 193:6,9,10 197:3 197:6 199:13 202:3,4,11,14 204:19 206:14 207:5,5,10,15 211:22 212:18 215:10 216:10,16 218:11 219:14 220:18 thinking 39:11 81:17 93:11 195:8 198:4 199:5,15 thinning 47:15 third 70:7 79:13 80:18 83:3 170:12 171:20 third-party 80:13 thirdly 87:2	thirteen 54:13 55:3 158:16 thirty 30:13,17 41:20 46:8 49:8 63:20 64:7 90:9 90:10,19 91:1 thirty-minutes 64:11 thirty-three 42:17 thirty-two 31:15 32:7,21 thirtyish 183:14 thoroughly 137:20 thought 9:14,15 13:6 23:13 25:14 26:2 59:19 125:16 157:12 178:8 183:3,11 185:2 207:7 208:1 thoughts 9:4 10:10 thousand 79:19 168:9 thousands 133:5 134:3,3 206:18 threat 200:21 201:15 threatens 106:5 three 22:20 36:15 41:15,16 44:4 45:4,8 54:3 74:11 79:17,20 86:18,19 98:15 104:17 116:22 123:20 127:1,9 129:4 134:4 140:12 147:17 156:17 157:3 threw 209:2 thrilled 24:12 36:15 throw 6:11 17:2 34:7 80:3 117:12 125:1 207:17 209:4 throwing 15:15 thrown 16:19 tie 18:1 tied 149:13 tier 216:15 tight 6:18 24:5 tightly 136:19 Tim 3:19 196:20,20 222:16 time 7:7,12 12:19 12:21,22 17:21 18:6 21:6 22:19 27:2 29:15 31:21	37:18 41:14 42:20 47:18 51:22 54:9 55:1 57:5 58:12 70:11,19 71:11,14 74:4,6,10 76:1,3 77:14 80:7 82:6 83:14 88:9 92:22 93:15 96:16 102:12 104:4 108:6,7 112:9 115:22 116:4,16 118:4,11 119:14 119:22 123:13,18 128:19 129:18 132:14 135:7 140:4 153:1 156:6 156:19 162:16,20 163:13 167:12 168:22 176:6,9 181:12 182:3 184:15 186:13 188:5,9 192:14 193:9,15,22 194:8 194:10 199:10 201:1 205:10 209:20 215:8 217:21 220:2 222:8 timeframe 24:5 timer 58:15 194:9 times 71:7 111:22 175:15 205:13 212:2 timing 51:8 83:13 tire 113:3 202:22 tires 156:13 158:11 162:9 title 114:3 119:16 to.4 187:10 today 4:5,8,10 5:19 6:12,16 7:4 8:8 9:7,22 10:3 11:10 12:15 16:5 17:14 18:15 20:22 21:2 21:11,18 23:9 27:9,10 36:12 53:20 58:16 65:21 108:18 120:17 127:9 128:8 130:5 134:12 155:20 161:22 189:4 191:9 194:5 196:4 196:8,19 197:3 201:9 206:1 207:18 211:22 218:18 221:14
---	--	---	---	--

told 58:12 99:15 148:16 152:10 214:4 218:11 219:11	8:5 10:15,17,22 12:12 13:22 14:1 26:14 85:13 122:9 126:14 129:2 130:13 133:3 155:5,8,14 162:7 167:22 171:6 176:13,21 200:12 207:9 215:15 218:4	trying 7:22 8:17 17:14 18:1 39:18 42:19 43:15 48:12 48:14 53:12,14 54:17 57:19 59:13 77:6 94:10 103:11 104:8,12 105:2 107:1 109:10 110:16 117:10 126:10 133:18 134:17,18 137:12 138:20 139:6 166:18 171:8 176:17 177:21 180:5 201:6 207:8 210:3 211:16 214:14 215:12	147:22 157:2,5 173:5 204:17 206:5,12 219:2 type 29:1 39:20 42:4,10 48:3 65:5 79:10 90:16 122:2 127:17 139:17 143:12,18 144:6 144:17,18 145:4 145:14,17,18 149:14 types 10:15 12:11 30:2 47:14 61:4 104:2 144:9,10 180:3 typical 61:20 62:8 62:20 63:4 106:21 106:22 107:8,9 126:15 127:1 144:11 202:15 typically 28:15 29:7 29:14,16 34:10,14 46:21 109:21 136:3 139:22 144:5,9 145:1,21 148:15 149:2 156:18 182:21 186:18 187:12	126:16,17 127:22 128:5,9 undermine 142:18 underneath 30:11 32:19 156:14 157:17 158:17,18 understand 7:19 24:17 50:15 55:14 67:6 84:12 94:8 109:7 112:3 125:19 162:14 170:18 194:8 198:8 understanding 15:22 51:15 138:19 155:14,17 162:16 211:1,3,10 understands 99:1 undertake 42:8 unfair 95:22 unfortunately 5:1 128:8 133:15 UNIDENTIFIED 128:15 uniform 71:14 uniformity 71:18 72:11 73:10 74:13 unique 68:7 130:14 167:22 184:14 205:4
TORA 198:21	transported 130:15 134:6 169:11	TTG 35:3,7	U	unit 168:20,20
total 31:22 54:12 153:18 166:3	transporting 122:21 123:11 170:2	tube 193:3,5	U.S 11:5,7 20:1 28:17 163:10 206:9	United 58:21 60:6 63:3 138:8 143:22 159:11,21
totally 36:16 94:8 179:11,20	trash 132:9	Tuesday 216:5	UK 149:4	universal 144:1
tough 138:2	travel 196:17 197:9	Tulsa 148:2	ultrasonic 46:14	universities 50:5
Toughiry 2:17 58:11,14 63:22 64:10,19 66:2,22 67:6,16,21 68:5 68:17,19 69:1 83:9 154:17	TRB 18:17	tune 101:8	ultrasound 44:2 50:14	university 43:10 49:16
TRD 215:15,16	TRB 18:17	turbulence 55:13	um 130:7 135:15	unlimited 165:18
treat 61:6 136:17 184:21	TRB 18:17	turnout 113:8	UN 28:12,12 29:4 30:5 35:3 37:7 39:4,21 40:14 41:15 69:15 77:15 77:18,19 78:6,14 79:12 81:4,5 83:7 103:17 107:14 109:8 114:1 120:9 128:3 131:10,11 168:1 169:21 171:1,2 172:7 202:7	unodorized 182:12 182:15
treated 112:4	TRD 215:15,16	turns 189:18	unregulated 130:17	unseen 63:13
treatment 44:1 47:7 199:3	treat 61:6 136:17 184:21	tweak 32:10	unstable 56:12	upcoming 69:11
trials 107:8 116:10	tries 119:7	tweaks 80:20,21	update 37:20 89:7 188:3 198:6 218:7	upper 62:1 146:4 147:3
tried 43:17 45:10 45:22 62:9 65:13 177:10 218:7	Trinity 43:11 48:22	twelve 30:19 32:7 51:22 52:2 76:11 99:10,11,11 120:18 158:16 161:3	urged 218:3	usage 9:10
tries 119:7	trouble 189:1	twenty 59:10 63:3 79:7 80:4 129:20 188:8	use 5:10 29:2 37:1 38:13 41:6 45:22 46:10 54:1 64:9 68:7 71:6,7 73:2	
trucks 56:7,9,15,20 140:21 156:11 185:10 193:16 200:17,18 208:10	truck 47:22 55:15 93:9 113:3 156:11 156:11,17 157:6 158:15 162:7 193:17 201:2 209:14,17	twenty-five 56:19 70:3 157:6		
Trucking 161:8	Trucking 161:8	twenty-two 52:12 two 6:2 7:7 9:9 27:16 30:8 31:1,4 31:16 33:2,3,5 36:11 43:13,19 45:2,3 46:21 47:22 48:13 54:9 57:11 59:19 61:4 62:13 66:9,13 67:2 69:15 79:14 87:20 88:11 91:22 95:2 98:15 100:20 101:2 102:22 108:10 111:12 114:6 116:14,15 118:11 123:13 125:12 126:7 127:2,12 132:19 146:17 147:8,18		
trust 52:2	truth 15:10,11	twelve 30:19 32:7 51:22 52:2 76:11 99:10,11,11 120:18 158:16 161:3		
TRV 57:16	TRV 57:16	twelve 30:19 32:7 51:22 52:2 76:11 99:10,11,11 120:18 158:16 161:3		
try 17:10 18:7 20:11 28:9 36:5 37:5 48:15 59:21 90:16 99:21 100:14 104:5 106:15 107:3 121:12 122:1 123:11,18 131:8 137:9 139:11,15 177:19 179:5 202:2 204:17	try 17:10 18:7 20:11 28:9 36:5 37:5 48:15 59:21 90:16 99:21 100:14 104:5 106:15 107:3 121:12 122:1 123:11,18 131:8 137:9 139:11,15 177:19 179:5 202:2 204:17	twelve 30:19 32:7 51:22 52:2 76:11 99:10,11,11 120:18 158:16 161:3		
transportation 1:6	transportation 1:6	twelve 30:19 32:7 51:22 52:2 76:11 99:10,11,11 120:18 158:16 161:3		

75:10 77:6 78:10 79:17,20 94:14 97:3,5 116:11,16 117:1,4 118:13,20 119:5 128:4 137:16 143:13,14 143:15,19,22 149:3,5 166:8 168:13,15,16 171:16 173:2,3,5 178:14 182:19 184:7 185:22 198:20 208:5 221:12	vent 145:19,21 vented 145:16 146:7 148:4 venting 146:11 venue 215:17 veracity 44:19 verbatim 105:9 verifiability 83:20 verified 83:5 verify 88:2 versed 142:22 verses 137:17 version 66:12 versus 72:18 74:9 126:22 129:11 vertical 31:6 vessel 185:18 vessels 154:12 vetted 25:16 26:5 vetting 26:11 viable 14:19 vibration 74:7 173:6 Vice 82:6 vicinity 105:15,20 106:4 112:16 video 31:17,18 52:17,21 57:6 66:11 125:2 166:15 videos 111:12 Villanova 20:4 Virginia 43:9 virtually 126:19 183:7 visibility 216:17 visible 146:5,20 Vocke 3:16 209:8,8 211:12 Volpe 85:13,14 volume 60:16 84:14 104:6 volunteer 49:18 volunteering 89:19 volunteers 89:11,17 91:7,8 92:7 Vos 3:5 100:16,19 108:13 109:15 110:18 113:21 120:22 123:19 125:6 197:16 199:16 vs 117:11,11 vulnerabilities 75:3	W8 193:21 wait 160:16 204:1 walk 5:10 114:13 walked 191:11 wall 33:7,8 want 5:19 7:3,13 8:2 9:3,6 13:3,9,9 13:11,16 15:6,7 15:10 17:6,15 20:12,17,18 21:17 22:18 23:11 24:6 25:2 26:13,19 27:7,8 36:1,20 40:2,2,14 50:2,21 52:22 53:4,17 54:10 56:5,13,17 57:15 58:3 59:14 71:17,18 72:16 73:4,7 74:8,12,21 75:20 80:21 81:9 81:21 83:17 94:4 96:2 98:16 99:4 102:12,16 104:10 106:10,17 107:16 110:2,8,18 111:5 113:7 116:2 117:15 119:8,21 120:2 121:20 122:11 123:14 124:12 126:20 127:18 128:18 130:20,21 131:1 133:20 134:6 135:2,9,10,22 137:19 139:13 140:11,18 142:17 144:2 148:18,20 148:22 150:10 151:21 152:8 154:10 155:11 160:4,13 161:10 164:1,10 165:16 166:8 169:10,14 170:12,16 171:10 173:17 175:5,6,7 175:20 176:12 177:16 178:17 182:10,15 184:14 185:4 191:9,15 192:2,17 193:3 194:4 195:15,22 199:12,18,22 200:2 206:15 209:10 210:15 211:21 212:5,8,15 213:9 214:3,18	217:6,12,17 218:5 219:3,16,16,17,19 219:20 220:3,8,10 222:5 wanted 19:11 23:12 26:10 30:12 32:22 35:22 43:20,22 44:3,15 49:13 50:11 75:8 76:4 88:6 96:12 101:1 111:11 122:15 151:5 199:14 209:21 wanting 41:2 wants 11:9 13:3 18:4 138:12 192:3 213:4 warehouse 146:10 was-was 51:2 Washington 1:8 wasn't 33:20,21 39:18 152:11 162:4 170:9,10 189:12 waste 96:10,14,14 97:9,14 132:6,6,8 132:9,18,20 133:4 133:12,19,20,22 134:17 135:2,15 136:1,14 207:2 watch 157:8 watching 48:4 166:20 water 6:3,4 29:18 30:21 32:11 140:20 189:12 190:2 193:15 waterway 214:17 waterways 216:3 Watson 101:4 way 6:18 21:12 22:7 23:5,12 26:21 36:21 46:5 55:20 60:21 64:15 66:15 71:22 72:7 76:6 79:22 93:7 107:6 116:2 117:16 119:4 124:13 144:19 156:3 158:5 161:14 162:13 167:2 173:9 183:21 184:18 189:3 192:17 196:17 197:1 198:5 201:10	204:15 210:14,19 217:5 ways 28:14 72:16 173:5 180:7 184:1 217:20 we'll 77:22 we've 38:20 163:16 201:18 weakest 72:7 wealth 20:7 weather 53:13 website 22:4 26:17 65:22 88:22 89:7 89:14 100:6 141:12,14 217:19 week 53:10 65:22 141:16 179:14 215:15,19 weeks 54:9 weight 62:12 168:20 176:15 welcome 27:18 151:20 153:5 213:13 weld 44:18,19 46:4 46:5 welding 44:19 welling 45:21 wells 44:2 45:19 46:15,16,16,16 went 10:2 49:17,18 109:3,4 116:22 119:12 197:9 204:3 218:19 weren't 51:9 88:8 111:17,17 191:12 Wert 67:1,1,11,18 68:2,16,18 West 160:16,20 166:2,13 200:4 201:11,22 wet 44:20 133:3 wheel 40:6 white 22:9,11,14 26:1 54:8 wide 59:10 107:13 widely 37:15 WILLIAM 3:12 willing 78:20 113:9 Wilson 208:4 winning 220:11,11 220:13 wiped 14:14 wires 175:19 wish 14:12 39:4 witness 33:21 102:5
V				
vacuum 145:5 vacuumed 45:10 vague 75:21 81:8 valid 39:8 163:21 value 55:22 83:22 144:7 221:10 valve 29:10 vantage 8:11 vapor 45:5 variation 169:13 variations 70:6 varieties 139:3 variety 10:18,19 86:6 138:3 151:11 various 33:11 38:11 70:6,16 76:5 115:10,16 133:8 133:22 135:11 176:10,17 vary 72:9 vast 125:15 vehicle 93:5,11,14 156:13 158:17 170:9 208:14 vehicles 56:6 185:14 velocity 176:5,7,8,8 vendor 95:21 98:18 vendors 94:15 95:14	W			

102:7,9 104:17 114:22 wonder 37:2 120:14 161:16 wonderful 19:11 21:20 wondering 64:12 150:17 Wong 3:15 19:8,12 188:4,4 213:7,8 wood 28:17 29:8,16 29:19 32:19 34:5 34:15 35:11 41:18 115:19 118:3 word 166:8 194:15 204:21 216:13 words 54:2 155:18 174:18 203:4,9,13 221:22 work 11:19 17:9,9 17:13 19:12,14 21:8,8,22 22:1 23:2 25:15 36:8 36:20 38:8 39:9 72:22 95:19 101:3 101:8 106:14 113:5 120:17 122:12,17 123:22 124:4,9 134:19 144:19 152:17 157:12 161:2,5 179:12,21 187:2 197:6,11,19 202:1 202:16 211:18 222:14 worked 12:17 18:19 22:21 97:21 workers 10:17 working 16:16 22:1 66:12 78:20 80:13 93:3 96:10 119:18 164:22 180:13 202:2 215:13 workload 197:21 works 32:1 74:13 77:10 118:5 132:2 145:10 workshop 87:21 88:1,2,5 workshops 88:10 199:9 world 17:7 28:17 60:7 138:9,21 195:8 201:7,8 worldwide 39:22 worry 8:15,16 16:1	117:13 worse 73:9 worst 219:22 worth 148:17 218:20 Worthington 152:7 152:11 worthless 117:6 worthwhile 120:20 162:14 180:22 191:6 wouldn't 19:9 22:15 42:3 110:18 145:10 184:9,10 184:14 185:20 186:8 187:18 221:18 wow 159:15 wrap 194:11 wrapped 60:8,11 write 21:13,15 22:14 23:3 42:13 100:4 write-up 21:17 wrong 109:11,18 156:19 wrote 36:17 <hr/> X x 138:14,17 205:14 x-rays 170:17 <hr/> Y yards 113:1 yeah 78:2 110:5 134:14 139:18 190:14 year 20:11 27:15,16 53:9,11 54:12 55:3 59:16 60:19 69:14 163:18,18 185:12 200:11 209:3 217:18 218:1 219:1,7 years 13:21 21:13 56:7 59:10 61:9 61:14,15 63:3,11 64:21 67:20 68:8 68:10 70:3 79:7 98:15 129:20,22 129:22 140:12 157:2 159:15 170:5,6,11 183:14 185:12 187:7 188:8,16 190:6 212:1	yesterday 36:4 yield 212:22 younger 47:13 <hr/> Z zero 71:1 157:3 201:7 zone 47:10,12 zones 45:21 <hr/> 0 0 201:5 <hr/> 1 1 172:19 1.1 103:14 115:2 129:15 209:1 1.2 115:2 1.3 115:2,14 117:11 126:4 129:6,15 208:20 1.4 115:2,14 117:11 139:9 208:21 1.4's 101:16 1.4S 100:22 101:13 101:14,17 102:6,8 102:15,18 103:6 104:1,14 105:8 106:5,11 107:2,9 107:9,11,12 108:9 108:9 111:15,21 112:2,3,17 115:3 115:15 117:11 1.5 159:18 208:22 1/17/2014 1:3 1:05 140:22 100 62:1 81:21 175:11 11 174:11,13 11,000 215:16 11,407 201:4 12 168:2,3,5 1200 1:7 139 201:2 14 122:8 149 62:2 15 33:17 104:6 106:6 150 172:20 174:2 174:15,20 16 175:17 165 144:22 173.301F 143:15 17th 160:16 1971 189:19 1973 201:3	1975 189:4 1976 188:20 1990 69:14 1999 47:13 <hr/> 2 2 144:17 190:21 2.3 143:21 20 121:9,11 130:7 2008 43:14 85:8 2009 57:7 85:9 2010 43:19 183:6 190:19 2011 43:14 85:11 85:11 2012 53:9 87:22 98:7 2013 43:20 54:12 2015 167:16 20590 1:8 21 85:18 86:19 87:6 91:13,22 92:14 212 145:1 21st 99:20 25 45:7 25th 90:8 91:2 26th 91:3 <hr/> 3 3 103:2 3.4 61:2 3:02 222:18 30 183:6 33005 85:19 35 147:13 176:13 <hr/> 4 4 102:6 103:2 145:13 201:4 4,500 60:17 40 174:21 190:5 40G 174:22 49CFR 53:1 <hr/> 5 5% 200:18 5.1 201:2,4 50 172:21 174:15 174:21,22 175:1 50% 200:18 500 188:6 53 156:10 53,000 146:19 5800 212:18 <hr/> 6	6 103:7 174:2,11,13 6.9 60:16 60's 44:8 60% 138:8 61 60:20 65 62:2 6A 103:8,12 124:2 6B 103:15 124:2 6c 28:12 29:5 32:17 33:12,13,20 38:15 104:3 114:1,4,19 120:13,21 124:1 6D 103:16 <hr/> 7 7 32:2 73 201:1 75 175:18 75% 159:10 <hr/> 8 8 104:20 121:10,11 8.3 31:22 8.4 31:22 8.5 79:6 8:30 1:4 8:40 1:12 80's 130:3 80% 200:9,17 800 29:6 31:20 32:6 41:20 104:9 86 218:6 <hr/> 9
--	--	---	---	--