CSB Public Hearing:
Safety Performance Indicators

Houston, Texas

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2 Opening Remarks

2.1 Rafael Moure-Eraso

When you are a chair of an agency, one of the privileges is you get to use this. So, let's declare this meeting started. Good morning, everyone. Welcome. I am Dr. Rafael Moure-Eraso, Chairperson of the US Chemical Safety and Hazard Investigation Board. I would like to get it started and call our meeting to order. Welcome to the CSB's public meeting on safety performance indicators. Today, we are going to have the opportunity to communicate a strong message that the development of process safety performance indicators is compelling, a compelling need to prevent catastrophic events in the petrochemical industry. How to prevent high consequence/low probability safety events in the petrochemical industry is a public health safety goal, a public health safety goal. This includes different parts of the sector of the industry: oil extraction in both offshore and onshore, oil refining and petrochemical production.

In 2007, the CSB issued recommendations to the industry following the 2000 fire and explosion at BP Texas City, an event that killed 15 workers and injured 180 others. In that investigation, CSB found that the root causes of the tragedy were the BP deficiencies in process safety management and process safety culture. CSB has claimed since then that in any given company, effective process safety management is shaped by a healthy process safety culture. So, was this explosion in Texas City an isolated problem of one company, BP? The question was addressed by the Baker Panel in 2007 that evaluated the safety of all operations in the US upon recommendations of the CSB investigation. The official Baker Panel statement reads: *We are under no illusion that deficiencies in process safety culture and process safety management or corporate oversight aren't limited to BP. So, CSB proposes that other petrochemical companies and their stockholders can benefit from the findings of the BP Texas City investigations by recognizing and acting to resolve those identified deficiencies.* But, today, we are here for the start of what I am sure will be an enlightening two-day event focusing on the effective development and implementation of safety performance indicators; indicators that we believe could prevent catastrophes by predicting safety performance and opening opportunity for prevention. A critical aspect of this two-day public meeting is for the CSB to be able to rely on the expert testimony of a number representatives from government agencies, petrochemical and refining industry members, trade associations and unions, nongovernmental organizations, public interest groups and other groups with a special interest and insights into high hazard industry sectors; all of whom bring their own unique viewpoint and expertise on matters of safety pertaining to major accident prevention. Many of our speakers have traveled a great distance to be with us and they represent a variety of best practice ideas and recommendations from jurisdictions inside and outside of the United States including Norway, the United Kingdom and Australia.

Before we get any further, I would like to address a few key administrative matters. First of all, in a room this size with the number of people, it's important to identify locations of emergency exits. We have the exit that you came in and we have an additional one on the other side, so we have those two emergency exits.

Second, we want to point out that there are a number of speakers and presentations that we are excited to see and hear and many speakers are going to be able to present their findings and analysis. We have printed a one-page agenda that is on the table in the front and also there is a more elaborated agenda in an additional document of six pages. The elaborated agenda has the pictures and the short biographies of all the presenters. So, please use those, pick up those documents. We will do our best to stay timely,

starting and ending as close as possible at the times that are marked here in the agenda. And this will make us more effective and be able to cover, give everybody their allocated time.

Third, I would like also to acknowledge the fact that this is a public meeting and the right of the members of the public to be here and the right to participate in our question and answer periods or asking questions to our investigators, to the board, and to the panels of experts that will speaking here. So, we expect to have time, as you will see in the agenda, for public questions. The way that we are going to work it out to make it easy is that you could start formulating your questions and you can send it through email to an address that is called question@csb.gov. That's one method of asking questions. They will be picked up in our website and sorted out and classified for try to respond to them in order and to be able to choose and put in as many as we can. As you can imagine, there might be a lot more questions than time, so we are going to cover, we have to choose of the questions that are provided to us. Also, there is old non-electronic method of ask questions. There are some 3×5 cards, you can also identify yourself, ask your questions and leave it at the front desk for the same purposes of sorting them out and being able – how many can we cover at the time of questions and answers.

So, the next item of the agenda is opening remarks is I would like to ask my colleagues in the Chemical Safety Board to say some introductory remarks and any statements that they have. And I will start with my colleague, John Bresland. So, John Bresland, please, you have the floor.

2.2 John Bresland

Okay. Thank you, Mr. Chairman, I appreciate the opportunity to thank the Chemical Safety Board teams for all of the hard work that they've put into this in preparing for the meeting, both the teams that are preparing the presentations and also our staff members who organized what appears to be at least so far in the first five minutes, a very successful meeting. Just looking at the number of people who are here, we are almost out of room, which kind of surprises me but I'm very pleased to see everybody here. And we're certainly looking forward to two days of I think what will be very interesting and stimulating discussions on the topics of chemical process safety indicators both on the onshore and on the offshore. So, I'll turn it over to, turn it back to the chairman.

2.3 Rafael Moure-Eraso

Thank you, John. The next board member that I will ask to make some remarks is Mark Griffon to my left. Mark.

2.4 Mark Griffon

Thank you, Mr. Chairman. Yeah, I want to also express my excitement. As John said, it's great to see a good turnout in the room. Excited to get our discussions under way. We have some great panelists for the next two days and it's a very important topic. I think there's clearly a lot of literature on the importance of process safety metrics. There's also quite a bit of literature pointing out that looking at just injury and illness rates doesn't necessarily mean, equate to your process safety.

Having said that, we still continue in our investigations to see a lot of evidence that that seems to show that companies are still linking bonus incentives, other things to those very injury illness rates that we don't think are tied to process safety necessarily. So, I think there is some work to be done. I think it's particularly important in the refinery sector. It's at least from my standpoint, I believe it's an aging sector with aging equipment and it's all the more important that these process safety metrics be developed and

that we have metrics that are used and put into effect, you know are effective metrics. Given the importance, I do feel there is some urgency on the implementation side. I think there has been a lot of discussion on development I think on urging that we move ahead with a little faster and a little more urgency on the implementation side. And that includes for internal use by companies either at the site level, at the corporate level or at industry sector level; and, beyond that, also metrics that can be used for comparison or for trends at the national level.

I think that we're going to hear this morning from- about the API 754 Recommended Practice and I think in some of these areas, it falls a bit short. That's at least my opinion but we hope that it can move forward and get to the right place. Today, I'm looking forward to hearing from a wide variety of panelists; some from different industrial sectors, also from different countries. And I think we have a wide variety of ways that they have used indicators; they also have various varying experience in the extent to which they've used them and the time in which they've used them. So, given my background, I'm particularly interested in hearing from some of our panelists from the nuclear sector. I think they've been at this a while and it would be very interesting to hear what their experiences are with metrics and how well they think they can improve or how preventative they are. Finally, I just would mention several key themes that I'm interested in hearing the panelists hit on over the next couple days.

One would be developing of effective metrics. Two, how do you make indicators matter. Just developing and tracking doesn't cut it; we need to, you need to see actionable metrics. Three is standardization and normalization questions. What can be standardized, in what situations does those two factors make sense or not make sense. Four, the role of the regulator in the use of process safety indicators. Five, reporting, and when I say reporting, I'm talking about internally reporting, corporate-level reporting or public reporting. And I think there's some real questions about if we go to some sort of public reporting format, there's benefits and possibly some drawbacks to how much you report and in what forum. And then the final thing I think is – and I might be a little redundant here – but the final thing is the type of data to be reported, what form is it in, is it raw data, is it aggregate data for the industry, is it site-specific, etc., those factors. So, I think we have great panelists many of which are going to hit on some of those themes and I look forward to a good dialogue with the audience and our panelists. Thank you.

2.4.1 Rafael Moure-Eraso

Thank you, Mark. At this time, I would like to first to recognize a person that has a lot to do for us being able to put this meeting together with the quality, the high quality that it is, and that is our Managing Director, Dr. Daniel Horowitz. And I would like for him also to give some introductory comments for this event. Daniel.

2.5 Daniel Horowitz

Thank you, Mr. Chairman. I'd like to join Dr. Moure-Eraso and the board in welcoming our distinguished panelists, guests and representatives of the news media and members of the public to this CSB public hearing. Thank you all for your interest in these hearings and for your continued interest in the events in the Gulf in April 2010. I would also like to thank our professional staff for your tireless work on this investigation in spite of many difficulties and obstacles that you faced. Most of the companies and organizations that we've worked with including BP, Cameron, Halliburton, the American Petroleum Institute and many government agencies and other groups have cooperated with the CSB's work and we are profoundly thankful for that.

I would like to particularly recognize the highly dedicated and talented CSB staff who have led and participated in the Macondo investigation including Don Holmstrom, Cheryl MacKenzie, Dan Tillema, Bill Hoyle, Kara Kane, Mary Beth Mulcahy, Kelly Wilson, Steve Cutchen, Jackie Shi, Chris Lyons, Mark Kaszniak, Ray Porfiri, Chris Kirkpatrick, Amanda Johnson, Lee Zarzecki, Jarad Denton, and many others.

I'd also like to thank our extremely energetic and capable public affairs and administrative team that has helped to organize this hearing including Hillary Cohen, Sandy Gilmour, Shauna Lawhorne, Amy McCormick, Allen Smith and Charlie Bryant.

Throughout the two years of this investigation, all of you have shown a selfless dedication to public service and to advancing the cause of worker safety and environmental protection, so all our thanks. I'd also like to thank our many guests and experts who have traveled here from literally across the globe to participate in this hearing. The goal of these proceedings is to create a shared understanding among experts, decision-makers and the public on the importance of effective indicators for major accident prevention.

The two-day hearing includes presentations and discussions on measuring process safety performance in a diverse array of high hazard industries. We look at sectors that have led the way in the development in implementation of both leading and lagging indicators for preventing major accidents. Fortunately, these major accidents are rare, though not as rare as we might hope. Because the accidents are rare, however, great efforts must be devoted to developing leading indicators that can provide advanced warning of disaster. Collecting, interpreting, and acting upon these often faint signals of looming catastrophe is a key mission for companies and regulators alike.

Over the next two days, the CSB staff will present a number of new preliminary findings from the agency's ongoing investigation of the Macondo blowout and explosion. These findings will focus on how performance indicators can help reveal safety management system weaknesses and thereby prevent the recurrence of similar disasters in the future. There are a number of other aspects to the investigation that we continue to develop and will be included in the CSB's final report early next year. I would like to take a moment to outline the principal events of the two-day hearing and you may wish to refer to the written agenda that you picked up when you entered the hearing room.

First on day one, we will begin with the CSB staff presentation from Don Holmstrom, the Director of the CSB's Western Regional Office in Denver. And Kara Kane, who is the staff attorney and investigator on our Macondo team. Mr. Holmstrom and Miss Kane will prevent – or rather – will provide an overview of the agency's years of work on the issue of safety performance indicators. They will review key findings and analysis from our BP Texas City investigation, which was completed in March 2007, as well as advances in safety indicators since that time.

Second, we will hear from Dr. Manuel Gomez, the CSB's Director of Recommendations who will provide a summary of the CSB's evaluation of the American Petroleum Institute's Recommended Practice Number 754. This recently developed guidance document entitled Process Safety Performance Indicators for the Refining and Petrochemical Industries was created in response to a CSB recommendation from our BP Texas City investigation.

And, third, we will have two witness panels where we will hear from representatives of labor, industry, and regulatory organizations in the petrochemical and refining sector as well as leading safety

experts from other major hazard industries offshore – or onshore, I should say. These panelists will talk about the development and use of safety indicators in the prevention of major accidents in these onshore sectors.

Today's session will conclude at 5 p.m. and we then resume at 9 a.m. tomorrow morning in the same room for our second day. We will begin our second day with a presentation of the CSB's preliminary findings on the Macondo blowout by Team Lead, Cheryl MacKenzie, Investigator, Kelly Wilson, and joined by Mr. Holmstrom. They will present evidence on how safety was managed in the Macondo project and on the influence of the regulator in driving offshore safety performance.

We will then transition to a panel discussion involving representatives of various regulatory agencies, stakeholder groups and public interest organizations. These representatives from the US and overseas will focus on the effective use of safety indicators in offshore drilling and oil production.

Next, we will hear from Mr. Peter Wilkinson, a former top regulatory official in Australia and expert consultant to the CSB team, with a presentation entitled *Safety Indicators: Where do we go from here*. You can all read Mr. Wilkinson's fascinating paper on this subject along with those of other participants on our website, csb.gov. And, over the course of the two days, we are accumulating all of our materials, PowerPoints, speeches, and so forth on that webpage which you can access from our homepage.

The hearings will conclude on Tuesday with a final panel of industry officials who will focus on specific examples of how industry is striving to improve the use of indicators for major accident prevention. And, let me remind you, as Dr. Moure said that throughout the proceeding, CSB board members, investigators and our audience will have multiple opportunities to ask questions of the panelists. We have scheduled question and answer periods throughout the two days of the hearing.

And just to recap those question and answer procedures. First, we'll have our questions from our board members and investigators, and then we'll have open period of questions. So, you can fill out your question on a card like this, you can pick up as many as you like. You can also email from your smart phones to question – with no s – question@csb.org and we'll pick up your question that way, or you can simply come up to one of the microphones and ask your question and we'll ask the panel to respond if they can.

The entire two days of hearings are being videotaped and a transcript will be available along with other hearing materials on our website, csb.gov. So, that's a brief overview of what to expect over the next two days. All of us are delighted, as Dr. Moure said, to see such a large audience for this topic here today in Houston and we encourage all of you to participate throughout the two days of meetings with your questions and your comments.

With that, I will turn the proceedings over to Don Holmstrom and Kara Kane from the CSB's Macondo investigation team will begin the first presentation.

3 Using Performance Indicators to Drive Improvement: CSB Overview-Donald Holmstrom

Thank you, Managing Director, Daniel Horowitz, and Chairman Moure-Eraso. We are really pleased at the turnout, in fact, that so many people also come from large distances and come here to Houston in July. That shows a really a real commitment towards this topic and towards safety and we really appreciate it.

The purpose of the presentation this morning is to get the conversation started about process safety indicators. We at the CSB want to renew and call attention for the need for industry and regulators to develop and use process safety performance indicators to drive measurable performance improvements. When we talk about indicators today, we mean measurements of events or actions that can prevent major accidents like chemical releases that have potential catastrophic consequences. The indicators we are most interested in are sometimes called process safety indicators or key performance indicators. When they are used within a safety management system, companies and regulators can use these indicators to track safety performance to compare or benchmark safety performance against other companies or facilities and to set goals for continuous improvement.

So, why are we holding this two-day public hearing, why focus on performance indicators? Well, to put it simply, we think this is really important. If the petrochemical industry, regulators, unions, stakeholders can work together to develop and use process safety indicators, we can prevent serious accidents and save lives. Unfortunately, not everyone has learned the lessons about indicators from previous catastrophes such as Texas City pictured here.

In fact, the CSB is reminded that process safety indicators are either not used at all or not used effectively in almost every incident we investigate. So, we felt it was essential to try again to get stakeholders to develop and use these indicators or to use them more effectively to drive safety improvements. As a starting point, we can look at one current CSB investigation at the CITGO refinery in Corpus Christi, Texas. In 2009, they had a major fire and release of hydrofluoric acid in the alkylation unit; but their safety record has been applauded and put forth as a great example. Here is a screenshot directly from the CITGO website which you can see in the bottom right of the slide.

The Corpus Christi refinery received the National Petrochemical and Refiners Association awards for safety performance and safety achievement in 2010. It shows that the refinery had a low recordable injury rate or a low rate of injuries that must be reported to the Occupational Safety and Health Administration like slips, trips and falls. How can that be the case of the Corpus Christi refinery experienced such a serious accident? Well, we think there is a disconnect between measuring safety as it relates to workers' personal safety and measuring process safety, which is much broader in its scope. Both are extremely important but both are separate and distinct disciplines with a different focus. Millions of US workplaces primarily measure their safety performance using OSHA recordable injury and illness rates. Typical injuries included in this data include slips, trips and falls. Collecting such data is also necessary in operations that have catastrophic hazards but it is not nearly sufficient.

Injury rates do not depict the effectiveness of a high hazard facility's process safety management program. The CSB has found many sites investigated by the agency that experienced horrific fatality incidents that also had low injury rates. In some cases, these sites had award-winning low injury rates. In every case, the CSB found major problems and process safety management programs at these sites.

This is not a new issue. Process safety experts have noted that the 1989 Phillips Chemical Plant incident where 23 workers were killed, the company had operated for several million man-hours without a lost time incident but still experienced a catastrophic series of explosions and fire. The CSB Texas City incident report noted that BP's personal injury metrics were described as the best year ever, yet there had been three major process safety incidents in that same period, including the 15-fatality March 2005 disaster. When we talk about process safety versus personal safety, we're mostly talking about apples and oranges. The table on this slide demonstrates that some of the fundamental differences between the management of personal injuries and the management of process safety are significant.

This slide examines the scope, prevention, risk, primary actors and some examples of the differences in the indicators. This is a simplification but I think it underscores the difference between the focus and the scope of process safety versus personal safety. We'll hear a lot more about OSHA during the course of today's conversations. OSHA regulates most of the petrochemical industry and we'll hear about it more later today. But, for now, keep in mind the way OSHA regulates safety necessarily impacts how the petrochemical industry measures the safety performance.

So, let's briefly review how OSHA measures safety performance, and, again, this is a very simplified presentation but it, I think it hits on some of the major points. OSHA primarily measures safety performance in all facilities including high hazard facilities using personal injury rates. OSHA's premier awards program, the Voluntary Protection Program or VPP is primarily based on personal injury rates. We should note that while in the wake of Texas City, OSHA's VPP program has introduced a PSM checklist submitted by the company. The primary measure of VPP performance and awards programs is still based on personal injury performance. Many VPP-covered facilities also have catastrophic hazards; but, nonetheless, OSHA's inspection priorities are mostly based on personal injury rates.

OSHA has conducted a national emphasis program addressing oil refinery process safety compliance and just program has been completed. Another program in the chemical process sector is currently underway. While we clearly applaud these efforts, neither of these programs are permanent in nature. More recently, the CSB investigated serious process safety incidents at the Valero McKee Refinery in Sunray, Texas, and Bayer CropScience in Institute, West Virginia. The Valero incident involved a major process fire and a significant chlorine release. The Bayer CropScience incident occurred as a result of a runaway chemical reaction and the catastrophic failure of a process vessel that had the potential impact- the potential to impact a nearby methyl isocyanate storage tank. Highly toxic methyl isocyanate was, as you know, the chemical released in Bhopal, India.

These are just two recent examples of CSB investigations of facilities that had low OSHA personal injury rates but still experienced a major process safety incidence that could have been catastrophic. Here is another recent example. In April 2010, the Tesoro refinery in Anacortes, Washington, had been scheduled to receive a National Petrochemical and Refiners Association safety award. NPRA is now known as the American Fuel and Petrochemical Manufacturers, a major oil industry trade association. But then it experienced a major process accident. The NPRA based their safety awards on injury rates. The CSB is investigating this incident where a heat exchanger catastrophically failed during a maintenance operation and seven workers died as a result. The use of key performance indicators is consistent with the CSB mission of making recommendations that will spur continuous improvement in safety performance.

The process of investigating an incident and finding root causes mirrors the process of using performance indicators. In each investigation, an adequate understanding of process safety risks and

deficiencies related to incident causation at all levels is crucial; otherwise, major accident events cannot be avoided. CSB incident investigations usually identify precursor events that led to the incident; similarly, indicators reveal safety gaps before an incident occurs. During the Texas City incident investigation in 2005, we studied earlier serious process safety incidents to shape our own investigation. Some precursor incidents at Texas City included previous blow-down system releases of flammable gas and liquid, a history of the failure to repair key instrumentation and a history of running outside safe operational limits.

Many other CSB investigations revealed similar warning signs. In the 1999 Tosco refinery incident, for example, there were previous incidents of draining flammable liquid to the atmosphere as a means to facilitate maintenance work, which is similar to the actual incident that resulted in a fatal fire.

I would now like to take a minute to clarify what we mean when we discuss leading and lagging indicators. Lagging indicators often refer to events such as recordable injuries, major spills, fires, releases, loss of primary containment. Leading indicators are events that do not result in severe consequences typically and usually address safety system performance. The lagging indicators can provide important data about the consequences of the actual operation of the safety systems. However, if facilities rely too much on lagging indicators, it's almost like they are driving down the road by looking out the rearview mirror. The UK Health and Safety Executive explains how leading indicators can prevent major accidents in its seminal guidance. I quote from the HSE: *Too many organizations rely heavily on failure data to monitor performance. The consequences of this approach is that improvements or changes are only determined after something has gone wrong.* Often, the difference between whether a system failure results in a minor or catastrophic outcome is purely down to chance. Effective management of major hazards requires a proactive approach to risk management so that information to confirm that critical systems are operating as intended is essential.

Switching the emphasis in favor of leading indicators to confirm that risk controls to operate is an important step forward in the management of major hazard risks. The concept of process safety indicators is not new. A series of three incidents at the BP Grangemouth refinery in 2000 and the subsequent UK HSE investigation prompted BP to acknowledge that the company needed to develop key performance indicators for major hazards but during our investigation as of the 2005 BP Texas City incident, the CSB found that managers and executive leadership had little awareness or understanding of the lessons from Grangemouth. Moreover, BP group leadership did not effectively address the need for greater focus on process safety management, including measuring PSM performance, nor did they resolve problems associated with BP, BP's decentralized approach to safety.

Why we at the CSB determined that a proper study of the Texas City investigation required understanding BP's corporate oversight of safety management systems and BP's corporate safety culture, both the way it was on paper and the way it worked in practice. Soon, after the CSB investigation was initiated, the board made an urgent recommendation to form an independent panel to complete this assessment. It was called the Baker Panel. The Baker Panel noted striking similarities between Grangemouth and Texas City, most notably the lack of management leadership, accountability and resources, poor understanding of and a lack of focus on process safety, coupled with inadequate performance measure indicators.

These PSM deficiencies first identified at Grangemouth showed up again at Texas City. It bears repeating that CSB investigations often uncover a management and workforce focus on personal safety that overshadows concerns about process safety. BP's corporate incentives program gives us yet another example from the 2005 Texas City incident. BP called it the *variable pay plan*. This plan was in place at the

Texas City refinery for several years prior to the ISOM incident. Class leadership categories accounted for 50 percent and safety metrics for 10 percent of the total bonus payout under VPP. For the 2003/2004 period, the only safety metric in this variable pay plan was the OSHA recordable personal injury rate. So, it makes sense that BP executives and others paid a lot of attention to OSHA recordable injuries at their plants. Unfortunately, a good personal safety record does not equal a good process safety record. Research from process safety experts Trevor Kletz and Andrew Hopkins confirms that too much focus on personal safety, while it is extremely important, can lead companies to become complacent about managing major hazards.

Since the 2005 incident, the BP Texas City refinery has made important progress on performance indicators. Earlier this year, BP Texas City managers and union representatives presented a summary of their new process safety indicators initiative in response to CSB recommendations. With a program largely run by union worker representatives, BP Texas City plant has incorporated a joint labor management initiative to promote the development and use of performance indicators based in part on the United Steelworkers Triangle of Prevention program. It is designed to catch near misses and data rich leading indicators that exceed the requirements of API Practice 754, which my colleague, Manuel Gomez, will discuss shortly. We are encouraged by the Texas City plant's extensive work to incorporate process safety indicators such as incident investigation action item closure, overdue plant inspections and tests and safety system demands.

We hope other refineries follow Texas City's example and implement these lessons learned. I understand that some members of the Texas City refinery group are here today and we wish to acknowledge their contributions. I'm now going to turn the presentation over to my colleague, Kara Kane, who will address the development and use of major accident indicators. Kara.

4 Using Performance Indicators to Drive Improvement: CSB Overview - Kara Kane

Thank you, Don. Lately our investigators have been thinking about the best models for the development and use of process safety indicators, so we've been carefully studying some guidance from regulatory agencies, industry groups and labor organizations. We've also talked to the people who wrote or contributed to this guidance because the CSB wants to understand the different models of regulation that promote the use of process safety indicators just as much as personal safety.

The UK Health and Safety Executive or HSE was one of the earliest adopters of process safety indicators regulations. In 1995, HSE began requiring companies to report health and safety data, and then they published annual reports based on those statistics. HSE first published a step-by-step guide to assist industry in the development of process safety indicators in 2006. And this is a really easy to follow guide that has since become an industry standard.

The UK Competent Authority, a council of three health, safety and environmental regulators in the UK, has published an exemplary strategic aim for process safety performance measurements. They aim by the end of 2015 that all major hazard establishments and duty-holders will measure their performance on the control of major hazard risks by way of key leading and lagging performance indicators.

Norwegian regulators unveiled their risk level project or RNNP around the same time the UK did and this project uses a broad-based set of models from statistical, engineering and human factors fields that helps the regulator in the industry record near misses and other predictive incidents. Then they use that data to update standards and conduct studies.

We have some valuable cross-sectorial guidance on indicators, notably from the Organization for Economic Cooperation and Development or OECD. They published an interim version of *Guidance on Developing Process Safety Indicators* in 2003 based on work done since 1998 by experts from a number of OECD member countries. They had worked in tandem with the UK HSC as it was preparing the step-by-step guide. And we also see some information sharing and development from the international regulators forum, that's a group of offshore safety regulators including the UK, Australia, Norway, Canada, the US, and several others. One of IRF's five areas of offshore safety priority is further development of performance indicators for measuring member countries' health safety and environmental performance. Some of you may be a little more familiar with the *Center for Chemical Process Safety Guidelines for Process Safety Leading and Lagging Metrics*. A lot of great guidance there.

And then in response to the CSB's recommendation from the 2007 BP Texas City investigation report, the American Petroleum Institute published Recommended Practice 754. And we'll hear a lot more on that very soon. Our investigations have taught us that the most effective indicators are measured in order to provide early warning of a high consequence accident so facilities can then adopt their own versions before the accident actually occurs. Before that is possible, the risks must be identified; and once the risks are targeted, indicators can be created and tied to precursor events.

As the Texas City investigation showed us, indicators can also tell us a lot about the safety culture of an organization. That's a concept that can be difficult to measure but if we know that temporary fixes, out of service equipment, things like that are normal, as they were in that plant before the incident, we have alerts that process incidents might be more likely. Some very valuable indicators of major hazard events center around organizational and human factors; and some examples of those that we have heard

about from people we've interviewed in the energy sector include inspection and maintenance of control systems, alarm management, shift logging, shift hand-over procedures, and plant override behavior.

To date, the CSB's Deepwater Horizon investigation team has interviewed and collected guidance from several organizations including government, NGO and industry groups in the chemical onshore and offshore oil and gas, other energy, nuclear and transportation sectors. CSB investigators have been to Norway, the UK, Canada, Brazil, and Australia to learn about how these standards were developed and how they work in the real world. We've asked people what does an effective set of indicators look like. Here are some of the more common attributes we hear about. Indicators must be compiled and analyzed collectively, one or just a few measures won't really tell us very much. Companies should normalize their key indicators so that they can benchmark those numbers for improvements. But it's also very important that these events occur frequently enough to be statistically robust, something that only happens once or twice a year doesn't really help identify any trends.

Some energy industry representatives we've interviewed told us they reviewed the indicators' data quarterly or even more often than that to review, add, or revise reporting instructions in order to catch more events if those results they were getting were too infrequent. At the same time, indicators should not be susceptible to gaming. For instance, some companies have told us they have initiated systems where a computer will automatically read indicators data into a database. For instance, an alarm will sound and then just send that instruction directly into a computer. And, finally, indicators must be actionable or it has to be clear what to do once you have that information. Effective indicators have to drive improvement, so they're precursor events that follow from the activity to be avoided. And accurately reporting is really key to do this, that's why a workforce has to be encouraged and feel comfortable reporting performance data.

In some cases, workers might require some sort of incentive or assurance that what they report is valuable; and this is one-way regulators can help make indicators work more effectively for their industries. If the regulator requires reporting, it's important it's highlighted and can become routine. We're also exploring whether public reporting of indicators data can help approve the effectiveness of the data. Some regulators we'll hear from today and tomorrow will publish their real time safety performance measures by the company and facility name.

So we'd like to discuss whether public reporting of this data in either a complete or a sanitized way is preferable. But what are some of the dangers for regulatory requirements for indicators? Well, if they're not properly targeted to the most serious process safety risks, then do they actually work against us by reducing time and concern paid to those risks? Don talked about several CSB investigations where we have companies that have excellent personal safety practices but almost no concurrent focus on process safety - but OSHA requires them to report personal injury data, not always process safety data.

OSHA officials have even pointed out that conventional injury and illness rates are not adequate indicators of catastrophic accidents. Companies need to develop better leading indicators to assess risks in their workplaces; however, OSHA doesn't yet require workplaces to report these types of process safety risks. So, where do we go from here? Well, we have several lessons that tell us how process safety indicators could have helped manage risk at industrial facilities, but simply collecting the data isn't enough; it must be incorporated into process safety management systems and used to drive performance. We also need to examine the role that regulators should play in collecting and analyzing these incident to guide their inspections or audits. This is something we've asked a lot of our panelists to discuss.

At the inspection date- stage, indicators data can tell us if a regulator – can tell the regulator, rather – if a company or the site's safety management program is functioning the way it was intended. And then after a triggering incident occurs, the data can alert the regulator to study and look at an incident that might not otherwise have warranted an investigation.

So, I'd like to close by just reiterating this goal of continuous improvement to prevent the major accidents like these pictured here. We just need to do some more work on this. We're really encouraged by the work on indicators that the BP Texas City plant has done as Don mentioned, and the work that the industry and the unions have put forth after Texas City. But let's continue this effort. Thank you. With that, I'd like to welcome our colleague, the CSB Director of Recommendations, Dr. Manuel Gomez.

5 Summary of CSB Evaluation of ANSI/API Recommended Practice 754 — Manuel Gomez

Well, thank you doubly, Kara, for helping me set up the computer as well as introducing me. Thank you, Dr. Moure. My job today is to review the CSB's evaluation of Recommended Practice 754 on Process Safety Indicators for the refinery and petrochemical industries which was developed by an ANSI committee of experts under the auspices of the API acting as the secretary, the facilitator, if you would prefer a simpler word.

My overall goal today is to contribute to what I hope will be a coherent story about indicators in the course of these two days, a story that will connect the comments that preceded me by my colleagues, the comments that I make as well as comments by many other speakers the rest of today and tomorrow. Before I begin, however, I should say that I think – I believe, actually – that if there is one point in which all of us in this room probably agree, it is that effective indicators that are properly used can be important, in fact, they are absolutely indispensable tools in the effective use of management systems to prevent high-risk incidents and to save lives.

And it is in the sense of that common spirit which I hope we share that I will try to make my remarks. This is what I plan to do this morning. I will go through the entire presentation. We'll have lots of question and answer and dialogue time afterwards. The first three bullets I will cover very quickly. That is a little bit of background on the CSB recommendation. You've heard a fair amount about it already. Something about the responses by the recipients and a bit of the summary of the Recommended Practice 754 itself. But my primary emphasis will be on the last two bullets. First, the fact that 754 makes some valuable contributions but it also falls short in some very important respects. Secondly, what the major conclusions of the CSB evaluation are and especially the need to address many of the shortcomings in the upcoming revisions. And then I will close with some very, very brief remarks on an improved potential future consensus process as well as the consideration of the possible role of the regulators in advancing the effective use of process safety indicators, a concept or a theme that I think will be expanded in the comments made by other speakers today and tomorrow.

All of us know what happened in Texas City in March of 2005. It is worth reminding ourselves that 15 workers died, more than an 180 were injured, many seriously, and there were serious property losses. As a result of our investigation of that incident, one of our major findings, as you have already heard, was that BP and the industry did not have effective process safety indicators to identify potential for high-risk events to trigger improved prevention of catastrophic events or incidents; and, that instead, the industry, BP and the industry – and by the industry, I'm using a very all- all-catching or all-capturing word – the industry was incorrectly using, and unfortunately still may be if you look at some of the industry annual reports, still may be using incorrectly personal safety measures as an indicator of process safety performance.

As a result, in 2007, the CSB recommended jointly to the API and the USW to develop a consensus standard for leading and lagging process safety indicators to improve performance in the prevention of high-risk incidents. The API and the USW were the recipients because they are the two main actors in the refinery industry; they are very important players as well in both the petrochemical and chemical sectors. But the intent of the recommendation was also, it was also to include many other

important stakeholders and experts in the development process, as I will reiterate several times during my remarks. And I think I forgot to turn the slide. My apologies.

Earlier this year only a few weeks ago, the board designated the recommendation with the status of "open-acceptable response." We have a process whereby the recipients of the recommendations submit materials to us describing what actions they have taken to implement it. We evaluate those at the staff level and then the process of deliberation ensues in which the board may ask us questions. We may request additional information from the recipients and so on. But, ultimately, the board makes a determination of what the status will be. In this case, "open-acceptable response" means in effect that the board judges that the recipient is moving in the right direction but that more remains to be done. The vote was two to one with Member Griffon voting against the motion because of his concern, and I quote in part, he has already partially mentioned that in his opening remarks that, "Some elements of the recommendation have not been adequately addressed."

And, in fact, how much remains to be done – how much remains to be done to meet the expectations of the recommendation will be a large part of what I will describe for you in this presentation. I'm clearly not doing my turning of the slides very well. I apologize again. This is the actual text of the recommendation. You can find it on our webpage and in the remarks that I make which will be made publicly available on the webpage as well. Incidentally, it says recommendations in plural because a related recommendation was for API and the USW to also develop a voluntary consensus standard for fatigue, which I will not be discussing today. It is very important but it has not been officially evaluated by our board.

It's easier if I summarize the main goals of the recommendation rather than to have you read a dry piece of official paperwork. The first goal of the recommendation, as you have already heard, was to develop and use leading and lagging indicators to drive performance and save lives. We can collect all the numbers we want but if we don't use them, they are absolutely useless.

The second goal was to facilitate public reporting of the performance of plants, companies and industry segments so that stakeholders could understand how well or how poorly they are doing compared to the past, compared to others, or to previously announced goals. It's also the kinds of uses that indicators should be used for. This second goal is no less important. Public reporting of performance is intended to act as an incentive to improve performance, much the way that the toxic release inventory that came about under EPA's Emergency Planning and Community Right to Know Act of 1986 uses those reports of the releases of toxic substances as a way to bring public transparency to those releases and particularly to spur reductions in releases.

The third goal was to, the third goal and also no less important, was to ensure that the standard was developed through a robust consensus process. This meant two things. First, that the process follow or adhere to ANSI principals of openness, balance, due process and consensus. But also that it included a diverse mix of perspectives and input from the relevant scientific disciplines and other industry sectors with indicator experience. You could say that the CSB recommended that the process follow an ANSI-plus process, not an ANSI-minimum process.

Maybe a little sideline in what ANSI means before I continue would be useful. The American National Standards Institute or ANSI is a private organization of longstanding and great prestige. It's our representative to the international organization – the US representative to International Organization for Standardization. But it has historically been engaged in the developing, development of commercial

standards, standards for the commercial marketplace; and I'm saying this in contrast to health and safety or environmental standards, which are a relatively minor part of their activity.

ANSI supports the development of voluntary standards, which have no force of law behind them unless they are adopted in government regulations or codes, which is sometimes but hardly always the case. ANSI provides procedures for a multitude of institutions to establish committees, expert committees and develop standards. But ANSI itself does not develop the standards. And most importantly, ANSI does not approve or judge the technical content of their standards; all that they approve or judge is whether or not the ANSI committees which are sponsored by a multitude of institutions have followed those basic procedures that determine that a standard is acceptable in that regard.

Now, to get back to the story. Both respondents initially accepted the recommendation. The API formed an ANSI committee as I described. The United Steelworkers joined. But about halfway through the process, the USW withdrew August of 2009 in protest for the imbalance of the committee membership. API went on and continued the deliberations with the remaining committee and issued the ANSI-approved RPC 754 in April of 2010.

You may wonder why I have ANSI-approved in quotes. That is not to challenge that it was in fact, that it is in fact an ANSI-approved standard; it's to remind you of what I said, that ANSI approves that procedures were followed, not the content, the technical content of the standard, they neither agree nor disagree with the content of the standard. I don't have time to do a review of the entire 754. I think the speakers later in the day will probably flesh out some of the brief remarks that I'll make, but I will do a summary. ANSI 7- I'm sorry. ANSI RPA 754 is based on the collection, use and some public reporting of four tiers of incidents or events. Tiers one and two are the more lagging indicators. We've heard a lot about lagging and leading, so my colleagues have already helped me out. They are defined by impacts, either human deaths or injuries, releases of toxics or flammable substances that exceeds certain thresholds and direct cost to the employers; whereas tiers three and four are the more leading indicators or events.

Tier three are challenges to safety systems such as triggering of pressure relief valves, to give only one example. And tier four are management system failures. The management systems that underlie the failure of control systems. And the 754 text says – and I quote, "That tiers three and four are intended for internal use at individual sites." It's also important that I comment on two commitments from the text of 754 that deal with its future development because we are here today not so much to talk only about what 754 says but how 754 will or should evolve in its upcoming revision.

In notes to the first edition, 754 says, and I quote, "Due to the entirely new nature of this RP, it is anticipated that the first revision cycle will commence after two complete years of data collection." End of quote. The CSB understand that this will occur next year, the revision, it will begin some time next year, although there has been no public announcement to my knowledge to that effect. 754 also speaks of – excuse me – transparent public reporting. But it indicates – and I quote again – that it may not occur for the first few years while the recommended practice is being implemented and the quality of the data is being validated. End of quote. The CSB is not clear yet when public reporting of any kind is expected to occur, what will be reported or what form the data validation described in this 754 is supposed to take.

I've put together something that I think or I hope will be relatively common or known by many of you in the audience is a depiction of the Swiss Cheese Model of accident of how accidents come about to illustrate how the four tiers of 754 sort of fit into it. I've used examples from only one set of barriers for

those of you who know the model – those of you who don't, hopefully I will make it clear in a few seconds – of only one set of barriers having to do with mechanical integrity.

As you remember or as I hope you will see from the slide, the model depicts a series of barriers – those are the rectangular figures on the slide – any of which can have flaws or gaps or problems in them. And it's only when those flaws align that major events – depicted on the bottom right of the slide in red, "tiers one and two" - major events with consequences occur. The logic of this Swiss Cheese model is that serious events don't happen because of single, simple causes; but that happen because of multiple causes. Now, let me walk you through what I have depicted here as tiers three and four. And it's only for illustration, please remember. The first layer, very early on, so you might think of it as a very leading layer is the design of mechanical indicator audits. What do you decide that you need to check to see whether or not – I'm sorry, mechanical integrity audits. What do you need to check in your management system to actually make sure that mechanical integrity is being maintained.

And, of course, one of the flaws that can occur in that barrier is that you don't identify the right things, you designed your audits incorrectly. The second barrier is the conduct of mechanical integrity audits. And you can conduct them poorly, that is, not check the right things and if you do, you miss them, then you miss the fact that there is a gap. And the potential for corrosion, for corrosion leading to a major event of course increases without your detecting it. The third barrier is poor follow-up. You can design and conduct the mechanical integrity audits very well but if you don't take action either immediately or promptly, then the gap can occur and it can progress to failure in mechanical integrity. And, lastly, the actual visible signs where you actually see small leaks or cracks, visible cracks, visible leaks and those would be probably just before the real potential, the real risk of a major event.

As you remember, this models describes the barriers, any of which can have gaps and if that straight line, straight arrow across, when the line, when the gaps align, that a major event can happen leading to tiers one and two, major events with consequences. As I hope I will make clear in the remainder of my presentation, 754 places its emphasis on accounting and on reporting to some extent primarily those events depicted in red, the events with serious consequences, rather than more leading events depicted by the barriers.

That's enough introduction. Let me turn to what the contributions of 754 are. 754 highlights the need and establishes some obligations. Again I have put it quotes because they are ANSI obligations, not legal obligations, not because I'm questioning them in terms of their importance. But some obligations for the use of process safety indicators in the industries. 754 defines a set of four tiered indicators that I have tried to describe for you earlier that incorporate the concepts of leading- of lagging measures with defined consequences to leading variables that are likely predictors of serious process failures. Many of the comments of my colleagues before me described some of these concepts.

Tiers one and tiers two are normalized as rates of incidents per hours worked, which I think intuitively should make sense to many of you. Now, normalization is absolutely critical. If you only have counts, of course you can't compare things because you can expect a very large refinery to have many more events – hopefully not many events but let's say many more leading events than a small chemical plant, simply because of size. And so you have to normalize according to something that allows you to compare. Tiers one and two are also potentially useful for evaluation of industry-wide performance. And I only put in the word "potentially" because of course it requires that you either report from all the facilities in a given segment of industry or that you have a representative sample reporting before you can have reliable evaluation of industry-wide performance.

No, let me stay here. And, tiers three and four provide guidance for the use of leading indicators but at the site level only and without standardized or normalized definitions, issues that I will get back to shortly. 754 includes incidents and hours worked by contractor workers in the indicator measures. This may seem like a "Duh" kind of thing but it is not. Indicators until a few years ago did not include the incidents that effected contractors or in which contractor workers were involved or their hours worked. And when we're talking about industries such as refinery where in many instances or in some instances as many as 50 percent of the workforce are contractors, this is a very, very important issue. So, it's an important advance. Indeed, most of the fatalities at the BP Texas City tragedy were contractor workers, they were not permanent employees. 754 also establishes some obligations – and, again, I'm using the quotes to refer to ANSI obligations – for reporting of lagging tiers one and two indicators but only for a more limited and ambiguous reporting for leading tiers three and four. Again, I'll get back to this. Let me turn now to the shortcomings that the CSB evaluation found in 754. First, the number of tier one and two events will be too small to provide effective performance indicators for many individual sites and even for some companies. There is really strong suggestive evidence for this conclusion or this assertion from many sources. If you look at data that existed before 754 came along, data that was reported to API and the American Chemistry Council, you will essentially even though the definitions of events were less inclusive, you will find that there were lots of zeros and ones in those data.

At the level of corporate reporting, not site reporting but corporate reporting, the numbers were very small. There is also data now reported from 2001 and 2010 by a group called CONCAVE which stands for the Conservation of Clean Air and Water in Europe. And despite the name, it is actually a research arm of the European Oil Industry Association. So, it's an arm of the federation of oil industry trade groups. And they have been reporting- recording to 754. Their data also suggests that the numbers at the site in corporate levels will be relatively small.

There is data from a pilot that was run during the deliberations of the 754 committee that for major, a very large facility for a major oil company in the US and that data also suggested that the numbers would be small. We have fragmentary data from a number of our investigations that suggests the same thing. And there's even some data in the literature for the broader chemical industry again indicating that Tier one and tier two types of indicators will have very, very small numbers even for relatively sizable facilities. But I am going to place my primary emphasis in the next few slides, a couple of slides in the data analysis from an expert statistical contractor that we engaged to look at this very question. The CSB contracted with a statistical expert from the Rand Center for Occupational Safety and Health to explore the power of tier one and tier two data to detect changes in performance for individual facilities as well as the power to perform certain key comparisons with reasonable certainty of being accurate.

And the comparisons that I'm talking about are the comparisons that we all know we need to make with indicators. The analysis of trends for sites, the comparisons of trends between two sites, the comparisons of trends between a site and a corporation and national averages, etc., etc. All of those are comparisons. Now, this issue of power (INAUDIBLE) can sound a little bit arcane but I beg you to bear with me through a little bit of a detour. Power is the probability of data, of data having the ability to reliably detect and effect. And an effect could be something such as the decline or the deterioration in the rates of incidents. That's what power is; the ability to detect that effect or the difference between the performance of two sites or two companies. And, by reliably detecting such an effect, I actually mean the ability to detect an effect with some assurance that is quote/unquote true, and more precisely, that is statistically significant.

So, power lies at the very heart of why rare events such as tier one and tier two are likely to fail as useful indicators except at the aggregate and national level. What the expert's analysis told us that when events are rare as I have just tried to persuade you will be the case in many facilities and even in some corporations, perhaps many corporations, that power to detect a change, a trend, a decrease, an improvement, whatever comparison you want to make will be small, will only permit us to detect very large changes, very large increases or declines.

And I'll try to bring that home a little bit in numbers terms. You actually according to the analysis we engaged, you actually would need to see a doubling of annual rates for many moderate-sized facilities. And, by moderate, I don't mean 100 men or 100 worker facilities, I'm talking about facilities that could have as many as 500 to 1,000 employees and contractors. So, fairly sizable facilities would need very, very large changes with the expected small numbers that are going to be reported.

The bottom line is that in a large proportion of refineries and in chemical plants and I expect that in the chemical industry as a whole, the distribution will favor even more smaller facilities than the refineries. But the number of tier one and two events will simply be too small to detect or measure changes in performance with any meaningful accuracy. Tier one and two definitions also don't count events that are reflective of process failures. I'll mention four examples. Tier one and two do not include loss of containment events when controls function as designed, they do not capture or count routine emissions allowed by law or regulation. They're called in Texas and in many other states on the Clean Air Act upset emissions. They're not counted under tier one and two. They're not counted if the thresholds occur in longer than an hour – or exceeded in longer than an hour.

The definition is according in part, according by thresholds of materials released, flammables or toxics; and if they don't occur in less than an hour, an hour or less, they're not counted. And then I'll use a very mundane example. Those of you who are acquainted with refineries will know what I am talking about. Leak fires that are controlled by steam lances would largely not be counted under tier one or two. Arguably, events such as these are potential predictors of worse events. If they were counted, they would considerably improve the power of tier one and two indicators for many needed comparisons' purposes. And I should also mention in passing but not because it's not important, that it is our strong impression that events recorded and investigated under the union management triangle of prevention or TOP programs in those facilities that implement those programs, including count these and other near-miss events, of other near-miss events as potential predictors of more serious events.

Well, I'm very proud of myself. I turned off my phone and it is vibrating. So I'm getting a call but you're not hearing it, so you should thank me for that. (*Thank you!)* You're welcome. Tiers three and four indicators are not defined in a standardized or normalized fashion so their usefulness will be seriously limited. Now, Kara already introduced this subject. Because these indicators are not standardized and normalized, that is, they're not defined uniformly across many sites and companies and they're not normalized, they're not turned into rates, they will not permit the kinds of comparisons that I had alluded to before.

I mean if you think of indicators as grades in a very simpleminded way, that means that a scale that gives you an A in one company or even in one site could very well be a C minus in another company's or site's scale. That is not useful for comparisons. And as I said before, the power of tier one and two comparisons will often turn out to be weak, as I have tried convince you of. Then 754 does not provide useful leading measures for any level except individual sites and even those will be limited because of the lack of normalization.

Another shortcoming of 754 is that the small numbers of tier one and two indicators will limit their usefulness to potentially understanding national trends only. That's because of the issues that I discussed before. Now, they may be useful for that if the reporting is adequate but that is all. The lack of standardized definitions for tiers three and four means that even if they are reported, they would not allow benchmarking, something that I have already, I think already begun or tried to discuss. They would only be useful for understanding performance trends at individual sites – if that.

The language of 754 speaks in terms of reporting summaries of indicators but it's not clear what those summaries will include. It makes us question whether that is in concert with the intent of the recommendation of adequately informing stakeholders. And, together, these facts indicate that 754 as I said at the beginning, will short of the CSB expectations for effectively reporting performance to stakeholders. Yet another concern of the CSB is that the protection of employees, supervisors or midlevel managements – managers who may report near-misses or who may insist on corrective actions following detection by indicators is not sufficiently emphasized in the recommended practice through "shall" statements, which is the way that ANSI standards try to make things obligatory.

And we don't have time to discuss that in detail. I may already running out of time very shortly but if you have an interest in this question, I urge you to compare the statements, the way that this issue is treated in 754 against another very important standard, ANSI AIHA/ANZI Z10 which deals and describes the ANSI, the American National Standard instituted for Occupational Health and Safety Systems. The language in those is much stronger. And, then, finally – I think it's finally – the CSB is also concerned that – no, not finally, I have a couple of more. The CSB is also concerned that whatever the reasons, whatever the reasons, the committee was not balanced or sufficiently diverse. Management members were in a large majority versus union and others. And, in fact, other stakeholders were largely missing, they were absent. Stakeholders like government, environmental groups, civic leaders, policy makers and others.

Now, lastly for sure, there was very limited if any participation of some critical scientific disciplines and other relevant experts, particularly statistics and epidemiology. I threw in risk communicators as well. Some of the comments I made before about the difficulties with the standards from statistical standpoints suggest that perhaps their presence would have been very helpful. And there was also very limited participation or input from other industries with indicator experience – nuclear, transportation or health care – who have struggled and are struggling with the difficulties of having good indicators and we could have learned a great deal from it.

In conclusion, the RP makes valuable contributions to encourage the use and some public reporting of lagging indicators as well as the use of leading indicators with more limited usefulness, more limited public reporting requirements. The RP's ability to drive performance improvement and inform key stakeholders will be hampered, however, by lagging indicators with insufficient statistical power, by the lack of well-defined standardized and normalized leading indicators that are needed for comparisons, by public reporting requirements that will be ineffective to adequately inform stakeholders.

And, lastly, by the lack of a broadly based consensus in the development process. What does this mean for the CSB in the future? And these are my concluding remarks. I only have a couple of more slides. Well, we continue to think that well-designed and well-used process safety indicators are an essential component of effective management systems that can save lives. And remember – I said we cannot forget the 15 people who died in Texas City and the 180, many of whom were seriously injured. So

the CSB will remain active in trying to advance indicators in the future. The CSB will obviously monitor future developments in RP 754 in the collection, analysis and public reporting of data. As soon as that begins to occur, the degree of adoption and use by not only the refinery but by the petrochemical and other chemical industry segments which we know very little about at this point.

And especially the upcoming accelerated revision of the RP that is promised in the notes which is scheduled to start we understand in 2013. We will advocate changes in 754 to address the shortcomings during the upcoming revision, ideally or in the best of all possible worlds, through a renewed consensus process if it can achieve improved balance, more diverse participation, increased scientific input for improved scientific rigor, and also the use of data which we understand is beginning to accumulate to test the predictability of different indicators because we want to collect data for indicators that are real predictors. We don't just want to have a lot of data. And you can also expect the CSB to consider the possible role of regulators in the design, collection, analysis and public reporting of process safety indicators. That concludes my remarks and I thank you for your attention.

6 Questions & Answers by CSB Board, Staff and Public

6.1.1 Rafael Moure-Eraso

Thank you very much, Manuel. The next item on the agenda is we start the process of question and answer, starting with questions and answers from the board to the staff on the presentations made this morning. The first person I am going to call is John Bresland. Do you have any questions?

6.1.2 JOHN BRESLAND

Thank you, Mr. Chairman. And thank you, Manuel, for a very thorough presentation. I guess my first question probably might be better held until we have the gentleman from Exxon API doing a presentation on how API developed this. But I'm just wondering why the – you talk about tier one, two, three and four – but it seems to be backwards. Tier one and two are the lagging indicators and tier three and four are the leading indicators. I'm just wondering do you know why they went in that direction because as I read them – maybe in years to come, everybody will understand this – but it would seem more logical to have tiers one and two as the leading indicators and tiers three and four as the lagging indicators. Maybe I'm being petty here.

6.1.3 MANUEL GOMEZ

John, you may be right that perhaps that question should be directed at the committee chair and vice chair and the members. But I would say that it's a model based – it's a consequence model and so the nomenclature was chosen to indicate that tier one and two were events with real and serious consequences, whereas three and four were considered to be more leading. Why the choice of one, two, three and four was selected, I'm not sure that I can answer it.

6.1.4 JOHN BRESLAND

And then on slide 21, you talk about the small numbers of tier one and two indicators will limit their usefulness and I guess you can look at that two ways. The first way would be if you're having a small number of incidents, that's a good thing. On the other hand, do we know how we would increase the number of indicators to make it more statistically sound? You would have to somehow change the definition of an incident, so that would result in more incidents to be reported. g

6.1.5 MANUEL GOMEZ

Yes, you would. I tried to allude to that by giving four examples of events, incidents. I don't know that incidents is the right word. But events that are not now counted under tiers one and two and that arguably are precursor events; that is are events that you could almost say predict or could predict the risk of a serious consequence event. So, you would have to count things that are more numerous. And that is the answer. The brief answer, John.

6.1.6 DONALD HOLMSTROM

Mr. Bresland, I would add that to add to what Manuel Gomez said that it's really perhaps looking at different things that are more data rich in particularly leading indicators. And one of the major points that we're trying to communicate is oftentimes the difference between a tier one and tier two event in a

major accident is the lack of a source of ignition or some other event that didn't occur by chance. And, so, it's really looking at leading indicators really has more preventative value rather than looking at infrequent or sometimes very infrequent lagging indicators because you're actually identifying safety system weaknesses. And that – and those types of incidents could be more data rich. And in tomorrow's presentation, we'll talk about some of the numbers that are reported to the offshore regulator and give some examples of those. The other aspect of infrequent events is that they really – as a practical consideration, they can't really be used effectively to drive performance improvements because if you want to say we're going to have a 10 percent decrease, for example, in these events but they're very infrequent, how can you drive incremental improvements in that system. So, that's a very significant issue as well and it also makes it more difficult to trend these issues if they're so infrequent.

6.1.7 MANUEL GOMEZ

And, Don, if I may add, Mr. Bresland, I did also try to make emphasis on the fact that tier one and two indicators if properly reported – and that's an important if, that is, if they are reported in a statistically random way from certain segments of industry, will really, really have the potential to track industry-wide or segment-wide performance because the numbers for those will be sufficient. So, in that respect, that is an important contribution. Again, it does depend on those segments of industry collecting the data in a way that will make it statistically reliable, representative of the industry. That was the first part of your question.

6.1.8 JOHN BRESLAND

Maybe this question, the next question is more better addressed to the group tomorrow. But when do we expect or when do you think we'll start seeing public reporting on either a company basis or an industry-wide basis?

6.1.9 MANUEL GOMEZ

I do not know. And I do hope that that answer will be, that we will have that answer before the end of our two days here.

6.1.10 JOHN BRESLAND

And I think as I hear the discussions on indicators, I think we need to be cautious that indicators are indications of a problem with a process safety management system but they're not, they're not a cure. You have to start off with a very strong process safety management system and then start measuring the indicators that would show that there are some failings in that system but you have to start off with the good process safety management system to begin with. So I will turn it over to, turn it back to Chairman Moure.

6.1.11 RAFAEL MOURE-ERASO

Thank you, John. Mark, you have some questions.

6.1.12 MARK GRIFFON

Yeah and just to – we didn't coordinate this, but, John, I'll pick up on what you were just saying. I think in my opening statement, I talked about the effective process safety indicators and I'm curious.

Several of the questions I wrote down I think are probably better also served for some of the panelists. But, I'm curious if in our research – this is either to the team or to Manuel – whether we have any examples that demonstrate where companies were using effective indicators and they showed measurable improvements. And I guess this gets back to that age old how do you measure safety and if there's no incidents. But there should be some precursors to a final event, so if they were using leading indicators effectively and it reduced substantially over a period of time the amount of releases or something like that, do we have any examples, I mean I think we might find some of this out from our panelists. But I'm curious if we've looked into that at all, if we have any good examples of that.

6.1.13 MANUEL GOMEZ

Mr. Griffon, I think that is an excellent question. I alluded to in passing – to it in passing at the end when I said that my understanding is that enough data are now being accumulated to ask and answer those questions. When I said that one of the scientific disciplines that might have been missing from the composition of the committee was epidemiologists is because those are the questions that epidemiologists ask. They ask the cause and effect question. To my knowledge, to my knowledge, there are no published, at least no elegant published reports that identify in rigorously scientific and statistical ways that Indicator A is a better indicator than Indicator B. However, as we begin to collect more and more leading data as well as lagging data in sufficient numbers, those questions – it will be possible to ask those questions. Quite frankly, the people who have that data are the companies and we would hope that they would engage in that kind of research and share the findings and publish the findings so that we can all learn to collect data and those indicators that are really predictive, which I believe is what your question is directed as- directed at.

6.1.14 DONALD HOLMSTROM

I would add to that, Board Member Griffon, that I think in the next two days you'll hear from real world examples of indicator programs where regulators and companies and trade associations are working together to report data and use it to improve performance, and there is some evidence that performance is improving from those systems. And, so, it will be an opportunity to ask questions about that and explore that. And, in particular, they're using both leading and lagging indicators and I notice that there's been some issues raised about whether leading indicators could be normalized or utilized in that fashion and perhaps they're only good for site-specific use. And I think you'll find in these other programs that leading indicators are being used in other parts of the world, in many cases, with the same companies that operate here in the US with success to drive performance improvements.

6.1.15 MANUEL GOMEZ

I don't want to leave you with the impression that somehow some rigorous elegant statistical studies will give us all the answers. You know if we are running an operation and we have gaskets that turn color because HF is leaking through them – hydrogen fluoride, I think most of us in this room would agree that we should fix that leak, that that is probably a pretty damn good – forgive me the French – indicator of the potential for a larger hydrogen fluoride leak. And I think we can give a lot of others where expert opinion would suggest that these are still pretty good things to look at and to identify now before something worse happens. I don't want to leave you with the impression that somehow we have to sit and wait until these elegant scientific studies are around before we can begin to use, effectively use indicators to prevent bad incidents.

6.1.16 MARK GRIFFON

And then just to follow-up. I think Don sort of touched on this. But a question I had about the more tier three/tier four indicators and the challenge to be able to standardize and/or normalize that data, even within an industry sector like the refining sector. Do you have- have we seen evidence that that can be achieved or the processes, the site-by-site operations too different to be able to achieve some sort of standardization because it seems to me that's a critical component to be able to instead of just working in a vacuum, you're able to share data across a sector and perhaps improve your local operation by learning from others. So, is it – have you looked into that challenge of in the refining sector can – are their possibilities for tier three/tier four data or indicators to be standardized?

6.1.17 DONALD HOLMSTROM

Well, I think it's a challenge, Board Member Griffon, to normalize any indicator. But I think you'll hear some evidence even today of companies using leading and lagging indicators internally across different plants and different even types of business operation and comparing them across the company. And so I think that work is already ongoing that currently is not, that work is currently not necessarily reflected in industry standards but it's something that obviously is important and I'm not underestimating the challenge of that work but I think that we'll have some examples in the next two days of people who are doing that and we can question, ask questions about how that was done and what are the successes and problems in those activities.

6.1.18 MARK GRIFFON

Thank you. I'll turn it back.

6.1.19 RAFAEL MOURE-ERASO

Thank you, Mark. I have one question to the investigation panel. You described with your slides nine, Mr. Holmstrom that after the accident in BP Texas City, there were some important developments that happened in the plant itself that address the issue of indicators. That was one of our recommendations in the investigation in 2007. I was present in a presentation that BP and the top committee of Texas City made on their activities, the health and safety activities, the joint health and safety activities at the Texas City refinery. And one of the things that impressed me was that in their process of collecting indicators what they were, one of the principal indicators they were collecting was something that was defined as near misses. And there was an evolving thought in refinery about how to define it because they found in some instances that there were reporting as much as 23,000 per year if you define the near misses one way and there will be a few hundred if you will define it a different way. So what I was wondering is in looking at that, a specific experience on using indicators that is taking place right now in Texas City, I wonder how your team evaluated that situation. What has been the successes or the approaches that you believe are useful to be looked in the future on the use of, on the definition of indicators for that will apply on the whole sector. So, my question is basically to elaborate in what has happened after our recommendations in Texas City.

6.1.20 BILL HOYLE

Mr. Chairman, I'll take that. One of the things we've learned from Texas City's joint labor management-

6.1.21 RAFAEL MOURE-ERASO

Excuse me. I don't think that you identified yourself. You could probably before -

6.1.22 BILL HOYLE

Okay. Bill Hoyle. Is that it's a worker-driven program. This is really exceptional. It's a worker co-designed program, administered, operated. And if you think about it, what is the source of important indicator information, it's what are the eyes and the ears of a facility – it's the workforce that's out there 24 hours a day, 7 days a week. They have to be empowered, they have to be engaged to report what's actually happening. And if you don't have that, all the indicators programs in the world that are in writing won't work. So, you've got to have an empowered, engaged workforce. In order to do that, the representatives of the workforce have to be the co-designers, co-developers, co-administrators to drive that program, otherwise, the things that need to be reported are not going to be reported. Now, in addition to that, the issues of fear of retaliation need to be addressed. I think we'll talk about that more in the next two days presentations.

6.1.23 RAFAEL MOURE-ERASO

Thank you, Bill. Any comments on near misses, anybody?

6.1.24 MANUEL GOMEZ

No, Mr. Chairman, I don't have one. But someone gave me a question.

6.1.25 RAFAEL MOURE-ERASO

Yeah we'll deal with that-

6.1.26 MANUEL GOMEZ

Okay I just wanted to – I wanted to alert to you it because I don't want to feel the person who submitted it to feel rejected.

6.1.27 RAFAEL MOURE-ERASO

All right. I have just another question. It's probably a small question. I am puzzled with a particular indicator that appear in tier one and tier two, has been described in RP 754 and also in some of our comments directly from the investigative team; and that is the indicator that is called “loss of containment.” And I see it in some places presented that loss of containment is a lagging indicator because it's something that already happened. But, on the other had, it could be a harbinger of a particular serious thing that could also happen in the future that could also be considered a leading indicator. So, my question will be – this is on the one particular example but I think there will be things like that that there is some gray area between lagging and leading. And I wonder what comments do you have, in which situations can we look at something leading that could be lagging and so on. Any comments on that?

6.1.28 BILL HOYLE

Well, I would recommend, there's a paper that addresses this by Andrew Hopkins on thinking about leading and lagging indicators that I think addresses this very eloquently. But I would offer this that

leading and lagging is a spectrum, it's a continuum, rather. It's a continuum, and in some circumstances, something may be leading and in another circumstance, it might be lagging. So, the most important thing is that we want to move the direction of reporting, the direction of what we collect to be as proactive, to be as front-end as possible and not debate so much what is specifically leading and lagging cast in stone. I don't think that's the nature of indicators but rather we want leading indicators because they're more predictive and therefore there's more of them and therefore they're more valuable and have more prevention power than lagging indicators. And, I'll just say on lagging indicators, one of the problems is we're dealing – when we're dealing with process safety incidents, we're talking about a special category of accident. They are low frequency but high consequence or a potential for high consequence. And, so, by their nature, we have to look at those precursors. Precursor events is the most important because the frequency by their nature of low frequency high consequence events is the frequency just isn't there to learn what we need to learn, so we have to learn in a proactive, in a predictive way.

6.1.29 RAFAEL MOURE-ERASO

Thank you, Bill. So, I guess this finishes the portion of the question and answers that are the questions of the Board to the panel. Now we move to public questions. And in order to facilitate this, I am going to ask our managing director to basically direct the traffic and facilitate the process of managing the questions from the public. So, Daniel, if you will, please.

6.1.30 DANIEL HOROWITZ

Once again, there are three ways that you can ask your questions or make your comments. You can fill out one of the printed cards that were available at the sign-in table. If you filled out one of those, if you don't mind raising your hand and giving it to one of our staff. Is anyone – okay. You can also perhaps more easily email your questions or comments to question@csb.gov and I'll attempt to read all of those. If you do not want your name used on your emailed question, please note that in your email. And, lastly, you're all more than welcome to come up to one of the mics and make your comment. Please – thank you – please do keep any comments brief and focus on discussion and questions on the matters we've been talking about. All right, well, I will start with some of the questions that have been emailed. And the first question is: *Does the UK Health and Safety Executive or any other organization currently have a safety awards program that includes effective process safety indicators.* And I think I'll ask Don and Cheryl if they and Kelly if they want to comment on that or defer it for one of the panels. Why don't you – why don't you come – Ian, why don't you come up to the microphone? And please state and spell your name for the transcriber.

6.1.31 IAN TRAVERS

Okay, good morning. Ian Travers, T-R-A-V-E-R-S. I'm from UK HSE. No. We- we-

6.1.32 DANIEL HOROWITZ

I'm sorry. We only accept complete sentences.

6.1.33 IAN TRAVERS

Okay. We don't- we don't have a national award system for companies that have KPIs, other than the real big award of not getting that much regulatory attention from us if your performance in relation to controlling major hazard risks is good. And I'll cover this in my presentation later today. But the straight answer to the question is no.

6.1.34 DANIEL HOROWITZ

Why don't you stay up because the second question also relates to HSE. And that is: *Does the UK HSE 2015 strategy to measure performance of leading indicators require that the major hazard sites report these publicly?*

6.1.35 IAN TRAVERS

Yes. So, two one-word answers there. But, that belies a fairly complicated position. We are, first of all, we require it through persuasion and influence rather than a formal regulation that all major hazard companies adopt a KPI program for their major hazards and that they use both leading and lagging indicators within that program. So, there's an expectation and a check from us that companies have got those measures in place. And, the last time I looked, I think 60 percent of our major hazard companies have in-house leading and lagging indicators.

6.1.36 DANIEL HOROWITZ

Okay.

6.1.37 IAN TRAVERS

The strategy is to get public reporting on performance by 2015 and that will be by company-by-company, rather than sector-by-sector, but we're still in negotiations, shall we speak, with the industry as we speak on the format and nature of that.

6.1.38 DANIEL HOROWITZ

And will the data be anonymous or will each company have to put its name out and the sites that are covered?

6.1.39 IAN TRAVER

Okay, I'm going to have to disclose some tactics here. We have this data and the tactics and the discussions we're having is, well, if we publish it, we will have to publish it on the basis of named companies; but if industry takes it on themselves to publish the data, then it can more readily be anonymous.

6.1.40 DANIEL HOROWITZ

Okay, thank you very much. All right, changing topics. The questioner writes: *Is there a quote healthy unquote number of leading indicator events, rather than striving for zero, too few – meaning the measurement is too coarse, and too many indicate a failure is imminent.* And I think I'll direct that to Dr. Gomez.

6.1.41 MANUEL GOMEZ

I don't think I have an answer for that of what is too few or too many.

6.1.42 BILL HOYLE

I could take that. You know the rich experience on the issue of too many indicators comes from commercial aviation and the Vice Chair of the NTSB, Chris Hart, gives an excellent presentation about this where he explains that in the civil aviation system where you have anonymous near miss or hazard reporting, I think the number – they collect thousands and thousands of these reports which are turned into lessons learned and annual reports. And they have hundreds of thousands of such reports in their database. And, so, it is there can be a problem of too many incidents or too many reports as they have in commercial aviation. But, I'll offer in the petrochemical industry that's not the problem we have. So, I don't think we need to solve the problem we don't have, I think we need to solve the problem we do have that we've got to increase reporting. And, hopefully, down the road, we'll have – we can have a meeting like this to discuss the problem of too much reporting.

6.1.43 KELLY WILSON

And this is Kelly Wilson. Over the last couple of months, something that we have learned is looking at the exact numbers of leading indicator incidents maybe isn't as important as the trends themselves. For a specific company, they may be higher or lower based on the definitions of your indicator or how you require that reporting. But the trends of the moving up and down, if you can't explain them could be indicative of some event or gaming event where you're requiring reporting but not doing anything about it or requiring reporting in that fashion.

6.1.44 DANIEL HOROWITZ

Great. Thank you. And, our next questioner writes: *I am so surprised to hear no mention of CERCLA reportable quantities. It seems that public reporting of TRI or toxic release inventory data is given some credit for helping to drive down releases as is appropriate. Is there also reason to believe that reportable quantity reporting, particularly in industries and materials that have very low RQs. In some cases, a release of ten pounds have driven process safety improvements in those industries. If there were, would that suggest that ratcheting down reportable quantities for some flammable and explosive materials could generate useful leading indicators?*

6.1.45 MANUEL GOMEZ

No, there was no mention of CERCLA; however, the definitions of 754 for tiers one and two are predicated partly on releases that exceed some degree thresholds that depend on the UN list of dangerous goods which is not all that different. Now, the second part of the question, of course, is a different issue, and it's the issue of ratcheting down those thresholds so that you would not only count more but also force the releases to be smaller. I think it's an interesting question but one that we have not examined at the board.

6.1.46 DANIEL HOROWITZ

All right, thank you.

6.1.47 JOHN BRESLAND

Daniel, can I comment on that? If you look at the CERCLA reportable quantities for some of the more dangerous chemicals – and I'm not going to mention specific chemicals here – those numbers are surprisingly high. Let's say you have a hundred pound release of a particularly toxic or corrosive material, a hundred pounds in a confined facility could be extremely dangerous. So, I'm – I don't know how

complicated it is for EPA to change those numbers. It probably is a fairly long regulatory process but it seems that would be a good direction to go in.

6.1.48 DANIEL HOROWITZ

Any other comment on that topic? Our next question is: *Dr. Gomez described the API approach and recommended practice 754 as being derived from a consequence-based model. This may make sense for reducing accident rates, but it seems illogical when the goal of the effort is to avoid consequences. How does the measurement of consequences lead to the avoidance of accidents? Did the group* – and I assume this means the API group – *consider the validity of this approach before they applied it.* And that may be – I don't know if you have any comment, Manuel, or we can defer that for our API reps.

6.1.49 MANUEL GOMEZ

Well, I would – I would – I called it a consequence model that was my own phrase. I would concur with Bill that this issue of whether something is leading or lagging is not one that we should get very stuck on. If you have a small leak, that's a consequence, something has actually happened, so you could say that's lagging. But it's certainly more leading than a very large release so that it's all in a spectrum. And that is the only way in which I referred to consequence. Now, to take that extrapolation even further; arguably, very, very high consequence events are also leading indicators for next year so that if you apply the lessons and you have a good system and you take the measures that are necessary that are suggested by that accumulation say in an industry segment of leading bad things that have happened, they're now leading because you're using them for improving your performance for next year. You could consider them lagging in that context. So, that differentiation, it's only useful in terms of the extent to which what you measure helps you to prevent the bad things from happening. I don't know if that – but for tomorrow as well, Dan.

6.1.50 DANIEL HOROWITZ

Okay, thank you.

6.1.51 RAFAEL MOURE-ERASO

I would suggest also that probably the question be repeated after our panelist from API talks this afternoon so that we can hear from him directly.

6.1.52 DANIEL HOROWITZ

The next question is: *Has the CSB compared process safety performance of VPP, voluntary protection program, versus non-voluntary protection program petrochemical sites.* Don, Bill, would you like to discuss that?

6.1.53 BILL HOYLE

We've not done a study of that issue. Our – we have investigated incidents at some VPP facilities or followed those and we should note that as Don explained in his presentation, there were some additions to VPP on process safety after Texas City, introduction of a checklist. But the – let's put it this way. VPP was not designed to be a process safety management program; it was designed to be an injury reduction program, if you study its origin and it's operations. That's a bit of an oversimplification but I think that reduces it to its essence.

6.1.54 MANUEL GOMEZ

Dan, I would add that if RP 754 changed in the direction of having indicators along the lines that I tried to suggest but also they were publicly reported at the site and corporate level, then the study would be done on its own. That is, one would be able to compare those companies and those sites that are or not VPP and see whether that might be an effect, might have an effect.

6.1.55 DANIEL HOROWITZ

And I know we have the OSHA Deputy Assistant Secretary here. I don't know if you'd like to comment on this issue of process safety performance. Okay, sounds good. All right, the next- the next question is: *Have the indicators been analyzed to determine if* – and I assume this means the API indicators, yes – *if they, one, would have been useful predictors for past major events and, two, do they reflect a high level of nuisance false warnings.*

6.1.56 BILL HOYLE

Say that again.

6.1.57 DANIEL HOROWITZ

Well, it was sort of I guess the question is what's the signal to noise in these indicators, are they accurate predictors with major events and do they reflect false warnings.

6.1.58 BILL HOYLE

Right and could they make a difference. One example I'll give is BP Texas City Refinery. Prior to the major release that resulted in 15 fatalities, it had been preceded by at least 8 similar releases of flammable materials from the atmospheric vent stack, the blow-down stack. And but under the API recommended practice, those would not be considered incidents or countable because they went to a device that was designed to receive what it received. So, it's not really a hazard based there, so I think that's a pretty important example that had, had those previous incidents been given serious attention, had they counted as process safety incidents, and given the importance that they should have gotten from that, that well could have helped to have prevented the disaster that happened in 2005.

6.1.59 DANIEL HOROWITZ

Anyone else want to contribute on that?

6.1.60 MANUEL GOMEZ

Well, certainly, no one disputes that there can be noise in indicators. We have to refine them. But I think that Bill is on target when he says that many indicators are predictive or we all think or we likely think that were predictive or likely predictive of worse events. But the issue of eliminating noise is a worthy one and one that will have to be examined and improved as we make our way and progress in the use of indicators.

6.1.61 JOHN BRESLAND

Daniel, may I make a comment? Just thinking back on some of the investigations that we've done and getting away from oil refineries, chemical plants and looking at the sugar refinery accident in Georgia where the sugar refinery exploded. If I were the CEO of that company, I think a perfect leading indicator would be the housekeeping standards at the facility. If you're building up piles and tons of combustible dust, you would think that some day, something bad is going to happen. And in that case, it did. And then a more current one, which about which, unfortunately, I know nothing, is the Motiva incident at Lake Charles where the refinery started up or it started up in the expansion, spent I think a reported $10 billion on it, and within two or three weeks, it shut back down again because of – I'd love to know what leading indicators could have been used in that case to prevent that from happening because it was- (It was in Port Arthur, I think.) -it was a very unfortunate financial situation for the company. And if I were the CEO of Shell or the Saudis who are the joint owners of that, I would be very interested in asking those questions – was there some indication ahead of time that we could have looked at that would have prevented that from happening.

6.1.62 DANIEL HOROWITZ

Thank you. Our next question is: How could ANSI approve this standard after the USW, the United Steelworkers withdrew and without other stakeholders need to ensure balance. And I think I'll refer that to Dr. Gomez.

6.1.63 MANUEL GOMEZ

Actually, it's a very simple answer. If any affected party wishes to challenge that during the course of an ANSI committee the procedures prescribed by ANSI have not been followed, they can challenge that, appeal that to an ANSI appeal process. Usually, it begins with there's an appeal process in the institution itself followed by an appeal process. In this case, there were no appeals so that ANSI did not examine it because no one challenged it.

6.1.64 DANIEL HOROWITZ

Thank you. On a similar vein, a question we received on a note card reads: *Diverse participation, why did the United Steelworkers walk out, why little participation of civic leaders, scientific staff or regulators.* And I don't know whether anyone from the USW wants to speak to that first question. If not, Manuel, do you want to just -

6.1.65 MANUEL GOMEZ

Oh, no. I don't think you'll get me to answer that question, Dan. I think that the answer to that question should more properly come from both the union and the API. … And they will all have an opportunity.

6.1.66 DANIEL HOROWITZ

They'll have an opportunity this afternoon in our panel.

6.1.67 RAFAEL MOURE-ERASO

This afternoon, I guess probably we should repeat that question.

6.1.68 DANIEL HOROWITZ

And the next question is: *If the leading indicator is a true KPI or key performance indicator for a potential incident, then doesn't the normalization of the data, the division mask the signal of the indicator? Why divide an excursion of a safe operating condition by hours worked? And that is an interesting question.* And I think I'll refer that to Dr. Gomez.

6.1.69 MANUEL GOMEZ

I'm glad you took that one. I was beginning to feel bad about that question because the little card was given to me. If some of you don't follow baseball, I'm sorry, but I'm going to try to bring that one home – forgive the pun – with a baseball analogy. The answer is no. If one guy is brought up from the minor leagues and he pitches one time as an emergency batter and he hits a home run, is that an indicator that he's a good home run hitter? Well, not really. It's an indicator that the coaches and the batting coach and everybody else should take a look at this guy and see whether he might turn into, become a good home run hitter. But it's a one-off event. Now, if a batter bats hundreds of times a year during a season and he hits 60 home runs – oh, and he doesn't take steroids – then is that a good indicator? Well, that's a good indicator because you have a rate; that is, he went to bat several hundred times and he hit 60 home runs and you can compare to everybody else and it's very hard to hit 60 home runs in one baseball season except again with some exceptions, and most people will not hit more than about 5 or 10. So, that's why normalizing. And, then, lastly, no one is challenging that when you have serious events you have to – and even serious near misses – that you have to investigate them, every management system contains that as a requirement, and that after you investigate them, you should act on them. So when you have those quote/unquote one-off events, you should always follow them up with an investigation and with corrective measures and with examination to the rest of your companies, to the rest of your sites, as well as examination to the rest of the effected industry.

6.1.70 DANIEL HOROWITZ

Anyone else like to add on that topic? Now a related and equally interesting question: *Is normalizing by worker hours, common but might it undervalue adoption of process automation? Example, a manually intensive process with three times the man hours but only twice the catastrophic failure rate may actually appear better if metrics are normalized only by worker hours.*

6.1.71 MANUEL GOMEZ

Well, I think the people on the committee who will speak later may address the – there was some debate as to what the proper variable for normalization, the denominator should be. Most people agreed that hours worked was a good an approximation other possible ones. And, in fact, it may well be that some sites may select things like you know volume of production or other – you know the hours of a particular unit operating and so on. And that's a perfectly reasonable type of exploration to make when you have indicators, particularly more tailored indicators to specific sites. I don't know if that answers the question, the theme of the question. I tried my best.

6.1.72 DANIEL HOROWITZ

Okay, I think I'll go ahead and name our questioner since I made our announcement. Again, if you don't want your name used, just make a note in your email or leave it off the message card. Mark Farley of

Pillsbury writes: *Does the CSB intend to make a recommendation to OSHA or BSEE with respect to mandating the recording or reporting of process safety indicators.*

6.1.73 DANIEL HOROWITZ

And perhaps I'll just answer that myself. But in our board process, ultimately it's the board that decides through a voting process what recommendations to issue and on what timetable. But as I think everyone recognizes, the CSB strongly believes in the value of indicators, thus the recommendation to API and USW several years ago and thus the meeting today. So, the purpose of this hearing really is to collect evidentiary information that the board can then evaluate and make some decision in the next few months about whether those sorts of recommendations might be warranted. I don't know if anyone wants to add.

6.1.74 RAFAEL MOURE-ERASO

Yeah, I would like to add that of course the results of the voting cannot be predicted, we have go through the process and we examine the evidence that is presented by our staff or the investigators to make the recommendations, and our recommendation department. At the level of the board, we examine all what is presented to us and then we have a vote. And a majority vote will decide if that is the recommendation of the board or if it is not.

6.1.75 DANIEL HOROWITZ

Thank you, Mr. Chairman.

6.1.76 BILL HOYLE

You know, that's a reasonable question and so I would urge our presenters and throughout the two-day hearing if they have insights into that conversation about where to do we go from here, that's why we're here is to find out where do we go from here. So, we want to be informed by the presenters and by everybody here about how to sort out the pathways forward on indicators.

6.1.77 DANIEL HOROWITZ

Great. Our next question comes from David Evans of Petrofac and he writes: *Do you recommend fixing the leading indicators for a period of time to allow data to be gathered, or should they be revised on a regular basis to reflect operational and management system changes?* An interesting question as well. And perhaps I'll refer that to Don and Cheryl.

6.1.78 DONALD HOLMSTROM

I'll just start out here by saying that when we talk about indicators, I think that there can be different types of indicators at different levels and so I don't think it's necessarily a one-size-fits-all except I think indicators, both leading and lagging, can be found to be key ones that should be collected both in a relationship I think on a corporate-wide basis, a facility basis and certainly something that's reported or perhaps used by a regulator to understand where problems are developing in terms of preventing major accidents. And those indicators might look different at different levels but there might be some commonalities between all of them. So, I think both actually could be operating. You could have a smaller set of key performance indicators; and I think we're going to hear about some of that in the next couple of days that are being used by regulators to identify issues, some used more than others. Sometimes, there's

joint programs between companies and workforce representatives and regulators to develop programs to drive performance improvements where they have identified, for example, I think offshore in the UK, three key indicators to improve asset integrity. And at a site level, you might have site-specific issues and you want to develop your own indicators what those problems are. There might be incidents that occur within a company or an industry that lead to new indicators. So, I think it's a multilevel, complex picture that is often best determined by all the parties working together in corporations deciding important priorities both on a corporate and a facility level.

6.1.79 DANIEL HOROWITZ

Cheryl.

6.1.80 CHERYL MACKENZIE

I was just going to say I agree and I think that what you'll hear from some of the panelists will be that these – many companies, especially the larger ones have numerous indicators that they're collecting data on and some of which are reported to the regulator and used for trending and determining you know the status of safety management by the regulator and by the industry. But I think some of these leading companies who are working with indicators are constantly seeking out new ones. It's that continuous drive for improvement. And you're constantly refining them and determining, well, if this one is not giving us any real information, let's hone it this way. And, so, I think that by them sharing what they've learned and their successes, we're able to come up with some strong ones that industry can use across the board.

6.1.81 DANIEL HOROWITZ

Thank you. Those are I believe all the questions that have been – oh, no, there's one more – no, I did cover that one. Those are all the questions that have been emailed. So, would anyone like to make a comment or a question? Steve, why don't you come up to the microphone and do be sure to spell your name.

6.1.82 STEVE ARENDT

Steve Arendt – A-R-E-N-D-T. I'm with ABS Group and I'm a Fellow of the Center for Chemical Process Safety. I have really a couple of comments and a question to the CSB. One is that first of all, in commenting on Member Bresland's question. I think when leading indicators, of course, are directed at trying to determine the health state of management systems; and, so, following an accident, if an incident investigation shows that there was a root cause that involved a particular management system, then it's likely that a leading indicator involving that could have highlighted it. On the other hand, for the incident that you talked about, if you would have determined whether the MOC process was effective at that plant, it could have highlighted and predicted a problem; but not always, it could be a one-off event. Secondly, I might refer you – first of all, the guidelines that you have evaluated are all excellent and they have all been building upon one another through the years. And I would also advocate looking at the OGP guideline, which is the most recent one that comes out that's very good. A lot of these talk about indicators, examples, strategies for developing them. But, I'd also ask you to consider the CCPS Risk-Based Process Safety Guideline that for the first time in 2007 established three new elements for safety management systems involving process safety culture, measurement and metrics, and management review. And, those structures give a company and an organization the essential features on how to have an effective management practice to develop and nurture metrics and to use them properly in management review and then also to advance the culture. And, then finally, a question to you all. I thought I heard several

inferences about other regulatory authorities doing something about helping to encourage industry. And, of course, our friends in the UK do that somewhat. I believe I'm correct in that the CSB has a rule-making authority on accident prevention reporting, accident reporting. And, you all began an effort to collect information on that. And while it might be a little uncomfortable for people to think about this, an artful interpretation of that statutory ability would be for you all to determine for people to collect and report this information. And I wonder where you all are in your thinking about that. Thank you.

6.1.83 DANIEL HOROWITZ

Thanks. That again is a decision ultimately the board will need to make about that reporting rule. I think the caveat that we would probably offer is that the board's ability to do a reporting rule is linked to incidents that cause death, serious injury or substantial property damage. I don't know; we would have to evaluate the degree to which it would extend into the area of leading indicators, things that presumably we would want to look at prior to those serious incidents. I don't know if anyone on the team would like to comment on that issue.

6.1.84 DONALD HOLMSTROM

Well, I think I appreciate Steve's comment in the sense that I think we all have to look at what we can do to aid in this effort and the CSB, we make recommendations to others and certainly we need to be looking at what we can do to aid in that process. I'm firmly convinced we're committed to doing that, so I appreciate the spirit of the comment. I think it's important for us to examine the ability of any organization. Government needs to be responsive and do its job and figure out what – everybody needs to figure out what they can do to make things better. So, I appreciate the comment.

6.1.85 DANIEL HOROWITZ

Any other – any other folks want to – Brent, why don't you come up to the microphone.

6.1.86 BRENT COON

When I approach the microphone, I'm supposed to say, "May it please the court." Ladies and gentlemen, first, thank you. As a resident -

6.1.87 DANIEL HOROWITZ

Please do, please do say your name.

6.1.88 BRENT COON

Oh, Brent Coon. C-O-O-N. I want to thank all of you for coming back to Houston. I want to apologize for the fact that you've had to come back to Houston. I represented many of the people that were killed and injured in Texas City. I represent some of those that were injured and killed in the Deepwater Horizon. And while we appreciate on behalf of the United Steelworkers and all of those who worked for BP in the petrochemical industry, what you guys do, there's still in my opinion, a fundamental gap. And we're all here to analyze gaps in the industry, but there's a fundamental gap in the process of why we're here and what we're doing. The reality – and I could be here for days – but the reality is that the petrochemical industry that we hear about today is internally conflicted with the goal of making money and not hurt anyone in the process. And that's the fundamental reality of what we deal with. When you

look at BP Texas City – and as lead council in that case, I took hundreds of corporate officer depositions around the world.

We reviewed millions of documents. Sitting on the work group committees within the Deepwater Horizon case, in the MDL in New Orleans, we reviewed hundreds of depositions and, again, millions of documents. And it's a process in the same old same old. When you guys came here three years ago with the 2010 final report of the 2007 early report, here is what's wrong with BP, here's what needs to be done to fix it. And we worked with the DOJ and all the regulatory and investigative agencies. Here is what BP needs to do better – and it's not just BP, it's the whole corporate industry. But they failed to do anything with that. They gave it lip service. And even last week, there was another hearing in Washington over additional fines that OSHA had negotiated with BP over the belated payment of the failure to fix many of the things that they agreed to fix seven years ago now in Texas City. They've been back in front of OSHA four times, paying tens of millions of additional fines, dollars in fines, over things that were found wrong in Texas City seven years ago that they agreed to fix that they are still working on. And I can tell you from working on behalf of the United Steelworker's members – and I'm their council down here for the thousands of them that work in the Texas City facility and others and as council for the many guys that work at ExxonMobil and other plants. The problems that you have at these facilities are not unique to BP. And when we look at these catastrophic explosions, that get everyone down here and focus their attention on what happened and why, it's because all those bullets they dodged, these near misses, the Swiss cheese – the bullet finally went through.

And, every day at every one of these plants, these guys working out there dodge some of those bullets. And it's for some of those reasons that the USW is not here officially participating with the (INAUDIBLE) report – they're frustrated. If you go back to Texas City, the flag, the United Steelworker flag for the many thousands of men and women that worked at Texas City for many decades, had been taken down in front of that plant before that explosion because of their frustration. They're very frustrated over the working conditions there. And, therefore, you do need to have stakeholders in these meetings. While we appreciate very much the academia that come in and look at these issues and try to analyze them, the reality is you have to deal with the fact that the companies are trying to save money, that what happened in Texas City was a gutting of the infrastructure.

The pressure to reduce corporate spending on process safety management, the protection of the assets, don't shut these units down every year or two; shut them down every four or five years, put clamps on them, do everything you can to keep them running 24 hours a day. Why? Because they're making money when they're running and they're losing money when they're shut down. And the plant management is pressured to keep these units running. And if you look at the Solomon Indices as a barometer of pushing the entire industry to failure, 97 percent efficiency isn't good; that puts you in the bottom quarter. You get fired as a plant manager unless you get to 98 percent and get in the second quarter. Those are the pressures within the industry that they all deal with. I think everyone here that has anything to do with the petrochemical industry – and I presume that most of the people here have a lot to do with it – all know that those bottom line fiscal decisions are what drives safety in this industry. And the only thing that you can do to make that much better is to cut to the chase and cut through the bull, understand why USW bailed out of this deal and say what do we need to do to properly review and audit and create and transparency in an industry that does not want to have the transparency necessary to save lives. And, I'm available 24 hours a day. I've had the pleasure of talking to a few of you in the past, Mr. Holmstrom and others. I'm available 24 hours a day. USW is available 24 hours a day. Other stakeholders are available 24 hours a day to talk to you guys or anyone else that really wants to know what's going on out there and what we can all do to make these plants better and safer and more efficient and reduce the

risk of lives being killed and of the environmental problems that you have associated with these releases. And, again, I thank all of you for being here. Look forward to the next two days.

6.1.89 DANIEL HOROWITZ

Thank you. Other commenters?

6.1.90 KATHERINE RODRIGUEZ

Hi, my name is Katherine Rodriguez. I'm here on behalf of United Support and Memorial for Workplace Fatalities. I also want to thank the CSB-

6.1.91 DANIEL HOROWITZ

Could you spell your name, please, ma'am?

6.1.92 KATHERINE RODRIGUEZ

Sure. Katherine Rodriguez, K-A-T-H-E-R-I-N-E R-O-D-R-I-G-U-E-Z. Again, here on behalf of United Support and Memorial for Workplace Fatalities. Again, I want to thank the CSB for coming out here to Houston, an appropriate place to bring this public hearing. I want to reemphasize the importance of the things that you are talking about today. Some of you have mentioned already that lives have been lost. Brent just mentioned you know eleven – I want to remind you again – 11 men lost their lives on the Deepwater Horizon, 22 men and women died at the BP Texas City Refinery within a five-year span; one of them was my father. And I want you all to realize that what we're talking about over the next two days is important because they are not just numbers, they are men and women with families who miss them very much. I know I miss my dad every day. They are not just numbers. They're not statistics. They are husbands. They are sisters, mothers, brothers, sisters, children and fathers. And it's important for what we hear today. My question to the CSB is both to the panel and the Board is with the public investigation of the March 23rd explosion at the Texas City refinery, have you considered any changes in your policy and procedures of including family members in your investigative process?

6.1.93 DANIEL HOROWITZ

Great. Bill, why don't you address this.

6.1.94 BILL HOYLE

Sure. Thank you for that question. Yes, CSB is currently engaged in an initiative to draft a new policy for review and possible vote of the board on family involvement or participation or communication that we would make routine in our investigations. We're already doing it in our new investigative work as a matter of routine, but we're going to codify that in a proposed policy for the board's consideration and we should get that done this year. And appreciate your asking.

6.1.95 DANIEL HOROWITZ

And I believe we held a roundtable, did we not?

6.1.96 BILL HOYLE

Yeah. We also held a roundtable some time ago where we had representatives from family organizations from around the country and others who helped advise us in what a good policy would look like. And we appreciate that.

6.1.97 DANIEL HOROWITZ

Other comments or questions? Okay, well, if not, it looks like we are right on schedule for the day, Mr. Chairman. Meeting is set to break at 11:30. Lunch is on your own. We'll reconvene in 90 minutes with our first panel discussion on the qualities of effective indicator programs, part one. That's one o'clock back here and we'll forward to seeing you all then. Thank you.

7 Qualities of Effective Indicator Programs (Part 1): Downstream Petrochemical & Refining

7.1 RAFAEL MOURE-ERASO – Introduction of Panelists

Thank you very much for going back to your seats and I think we are going to continue the program. This afternoon, we are pleased to have with us a distinguished panel that are representatives from government, industry, stakeholder groups and who will talk to us about qualities of effective indicator programs. Joining us today is Mr. Kelly Keim. He is the Vice Chair of the ANSI/API Recommended Practice 754 Task Group and Chief Process Safety Engineer of ExxonMobil Chemical. Also with us is Mr. Jordan Barab, the Deputy Assistant Secretary for Labor for the Occupational Safety and Health Administration also former Assistant Secretary for OSHA. And also Mr. Kim Nibarger from the Health and Safety and Environmental Department of the United Steelworkers International Union. We thank all of you for being here and we will start the presentations with Mr. Keim. Mr. Keim.

8 KELLY KEIM – Process Safety Indicators for Major Accident Prevention

Thank you, Chairman. Mr. Chairman, Members of the Board, CSB staff, thank you for allowing me to have this opportunity to present on behalf of the American Petroleum Institute and the team that developed the ANSI standard, API RP 754. In March of 2007, the Chemical Safety Board issued Recommendation 2005-4-I-TX-6 to the American Petroleum Institute and the United Steelworkers to, quote: *Work together to develop two new consensus American national standards institute standards. In the first standard, create performance indicators for process safety in the refinery and petrochemical industries, ensure that the standard identifies leading and lagging indicators for nationwide public reporting as well as indicators for use at individual facilities. Include methods for the development and use of the performance indicators.* End quote.

In May 2008, the API initiated its response to the recommendation using the ANSI principles of openness, balance, due process, and consensus. Following extensive efforts to secure representatives from a broad spectrum of stakeholders with a direct and material interest in process safety, a consensus committee was formed to develop the ANSI standard for process safety performance indicators. It included representatives from academia, industry trade associations, engineering and construction companies, government, labor organizations, and owner operators in the refining and chemical industries. As a result, the American Petroleum Institute was able to publish ANSI API RP 754 Process Safety Performance Indicators for the refining and petrochemical industries in April of 2010.

A starting point in the development of any set of indicators is to define the scope as pointed out by the Baker Panel. Excellence and personnel safety statistics is no indication of process safety performance. The scope of process safety is multifaceted in that it strives to prevent harm to people, the environment and to property resulting from the loss of containment of materials from process facilities; therefore, RP 754 has established performance indicators for process safety events or PSEs, challenges to safety systems, and operating discipline and management system performance. The performance indicators have been placed into four tiers as depicted on slide four. Tier one represents loss of primary containment, LOPC, events of greater consequence; with tier two being those events of lesser consequence. Tier three includes events described as challenges to safety systems and tier four includes records of events or measurements of performance of operating discipline and management systems.

For any indicator to be useful in benchmarking between organizations, that indicator must be precisely defined such that it can be consistently and objectively used and interpreted; therefore, RP 754 includes standard definitions of tier one and two that can be applied unambiguously throughout the refining and petrochemical industries. Standardization of tier one and two definitions results in their suitability for public reporting at any organizational level. The refining and petrochemical industries include a wide spectrum of processes ranging from complex facilities operating at extremes of pressure and temperature and unit operations from simple blending to highly exothermic reactions. These differences require a variety of site-specific and company-specific barriers and management systems to mitigate those hazards. As a result, a greater degree of flexibility is necessary in defining indicators of process safety performance in tiers three and four, which are intended to provide the greatest opportunity for learning to drive performance improvement at the site and company level. The RP 754 standard requires that companies shall develop and use process safety indicators at all four tiers. The 754 standard provides suggested indicators at both tiers three and four along with guidelines for the selection of process safety indicators and references to other sources that provide a more in-depth treatment of this topic.

The four-tiered approach to process safety indicators recognizes that there is a continuum from those indicators that are most lagging to those that are most leading. As Andrew Hopkins points out in *Working Paper 53, Thinking About Process Safety Indicators*, quote, "*The most important point to emerge from the UK HSE document is that process safety indicators must be chosen so as measure the effectiveness of the controls upon which the risk control system relies. Whether they be described as lead or lag is ultimately of little consequence.*" End quote. The message is clear. The use of indicators to drive change that prevents LOPC events resulting in harm is what is important. I will briefly describe the indicators at the four tiers. Tiers one and two described as process safety events; they include any unplanned or uncontrolled release of any material, including nontoxic and nonflammable materials from a process that results in one of the following consequences: harm to people, impact to the community, damage to property or a release of a threshold quantity of material.

Thresholds are based on the UN Globally Harmonized System for Classification representing the potential of that material to cause harm. This standardized definition allows for normalization to allow performance comparisons of companies and sites of different sizes. The PSE rate is defined as the number of PSEs times 200,000, representing 100 workers per year, divided by the total workforce hours. Tier three performance indicators represent challenges to barrier systems that progressed along the path toward causing harm but were stopped short of tier one or tier two PSE. These include exceedance of safe operating limits, demands on safety systems, results from inspection and testing on primary containment systems that fall outside accepted limits, and other LOPC events of lesser consequence than tiers one or two.

Based upon the Swiss Cheese Model proposed by British psychologist James T. Reason in 1990, tier three indicators are selected to identify weaknesses or the absence of barriers that are intended to prevent LOPC events. Indicators in tier four represent the performance of individual components of process safety management systems and the operating discipline with which they are applied. These are also selected based upon Reason's model to be indicative of weaknesses or the absence of barriers that may contribute to future tier one or two PSEs. Examples of indicators in tier four include performance at closure of process safety action items, process safety training completed per schedule, completion of inspection and maintenance checks on safety critical equipment, as well as the performance results from those checks, completion of emergency response drills by operating and emergency response forces.

Conformance with RP 754 requires that companies develop and use process safety indicators at tier four. Selection of those indicators and the frequency of their measurement should be based on the management systems a company uses to manage the process hazards of the facilities they operate. The ANSI Board of Standards Review approved API RP 754, Process Safety Performance Indicators for the Refining and Petrochemical Industries on April 13th of 2010. API published the standard nine days later on April 22nd. To ensure the broadest access to the standard, it was made available at no cost and remains available for viewing without fee. To facilitate rapid adoption and use of the standard, a task force of committee members was created to develop a series of webinars which are still available at the API website to introduce the standard, to provide a means for companies to seek interpretation of the standard on an ongoing basis including posting a response to those questions on its website, to continue to host webinars that help other companies use and interpret the standard and to present the standard and its use at industry association conferences and symposia on process safety. As a result of these efforts and the benefits companies expect from implementation and use of RP 754, it has been rapidly adopted throughout the refining and petrochemical industries and beyond. A number of trade associations have committed to collect process safety indicator performance since 2010. They include the American Petroleum Institute, the American Fuels and Petrochemical Manufacturers Association, the Oil and Gas

Producers, and the European oil company organization for environmental health and safety, CONCAWE.

In fact, for 2011, 32 companies representing 92 percent of US refining capacity and 25 companies representing 98 petrochemical sites reported data to the AFPM. 21 companies representing 82 refineries and 91 percent of US refining company capacity reported 2011 data to API. 22 companies reported 2011 to OGP. The American Chemistry Council conducted a pilot in 2011 that allowed companies to report required responsible care process safety performance on the basis of RP 754. The International Petroleum Industry Environmental Conservation Association, IPIECA, has endorsed RP 754 for corporate sustainability reporting. During the vetting and balloting period, positive comments were provided by many external stakeholders including the United Kingdom Health and Safety Executive.

An indication of the usefulness of RP 754 in driving improvement of process safety performance is the average of 50-plus attendees on quarterly webinars held since the third quarter of 2011 to discuss the use of the standard. Another is the number of presentations being made by company users at process safety conferences across the globe. Since the standard was published, there have been many presentations from users, including 15 at recognized and well-attended conferences such as the International Symposium at the Mary Kay O'Connor Process Safety Center, the AFPM National Occupational and Process Safety Conference and Exhibition, the ACC Responsible Care Conference and the CCPS Latin American Conference on Process Safety.

Many of the presenters highlighted the increased emphasis that process safety had received within their companies as a result of having a standard and objective means of measuring their process safety performance. Most presenters talked about focusing their efforts on the identification of process units and equipment most frequently involved in tier one or two PSEs. They used the results of the investigations of these events to identify causal factors and performed trend analysis on the aggregation of those incidents to identify the greatest opportunities for improvement. Furthermore, some identified the use of tier threes or some portion of those in their trend analysis and the investigations thereof.

RP 754 requires transparency in reporting of process safety performance. At the broadest level of public reporting, each company is required to report tier one and two PSE information on an annual basis. As with any system of measurement, there is a period of implementation and validation before results are meaningful for publication or comparison across organizations. This time is required to educate employees, establish reporting systems, and to resolve questions of interpretation to assure consistent application of the standard. 2010 was a year of implementation of our RP 754 for most companies. Based upon data submitted for that partial year, opportunities for clarification of the standard were identified. These clarifications were delivered in a webinar held in February of this year. The API has also posted 25 or more new items clarifying the classification of tier one or tier two events in the frequently asked questions portion of its website devoted to this standard. Reporting of process safety performance may be directly from individual company or through industry trade associations, through government agencies or via other means.

The API expects that following collection of 2012 data, there will be a level of maturity whereby industry aggregate performance figures of tier one for that year may be published. For 2013 data, API expects to publish company-blinded results that will allow companies to begin to judge their performance relative to their peers. Publication of industry and company transparent results is expected for 2014 data. The reporting of tier two performance may lag that of tier one by one year as a result of less mature reporting systems at that level. At a local level, each site must determine the appropriate methods to

communicate PSE information based upon the size of the site and the size of the community that it has the potential to impact. Annually, each site must report its site-specific tiers one, two, three, and four PSE information to its employees and their representatives.

Each site must also make available a summary of site-specific tier one and tier two PSE information and may report site-specific tier three and four information to its local community and the emergency management officials. Two complete years of PSE data will have been collected by the end of 2012. Following an analysis of the data submitted in 2013 to API and AFPM under the *Joint Advancing Process Safety Program for Process Safety Indicators*, it is expected that the RP 754 standard will be open for revision as recorded in the notes to first edition. Throughout the development of RP 754, the standard was written with the belief that it should be applicable to any process industry, including those beyond the scope of the CSB recommendation. Since it was published, the standard has begun to find acceptance outside the refining and petrochemical industries such that the scope of stakeholders has broadened. To that end, the API 754 Implementation Task Force has been working to gain the interest of an even more diverse group of stakeholders with a greater degree of international representation for this revision.

CEFIC, the European Chemical Industry Council, and representatives of several Latin American organizations have already expressed an interest in participation. The API believes that RP 754 has already made valuable contributions in the area of process safety. It establishes a means of measuring process safety performance in a precise, consistent, and objective manner; it establishes the requirement for the development and use of leading indicators for companies to use for performance improvement. And, finally, it sets requirements for transparency and the reporting of process safety information to the public, employees and their representatives and the communities around process industry sites. Thank you once again for the opportunity to share information related to the development, adoption, use, and continuous improvement of API RFP 754 Process Safety Performance Indicators for the Refining and Petrochemical Industries.

8.1 RAFAEL MOURE-ERASO – Introduction of Jordan Barab

Thank you very much, Mr. Keim. I am asking that people hold their questions and we will ask it as a group after the panel finish. Our next person in the panel is Mr. Jordan Barab, the Deputy Assistant Secretary from the Labor Department from OSHA. Mr. Barab.

9 JORDAN BARAB – OSHA's Refinery and Chemical National Emphasis Program

Thank you, Mr. Chairman, Board Members, the staff. Thank you for inviting me here today to testify. As you're probably aware, safety in the refinery and petrochemical industry and chemical industry are a major concern of OSHA and developing better indicators is also a major area of interest for OSHA. OSHA, as you know, is primarily an enforcement agency but also very much a compliance assistance agency. We basically want to make sure that American businesses are safe. Enforcement is one of our major tools but we have many other tools as well in our satchel in order to take a more balanced approach. It's no news to OSHA; it's nothing new that there are major safety and health problems in the refinery industry. This was probably most evident over 20 years ago after the Phillips 66 explosion which led, which among other things including Bhopal, led to the development of our process safety management standard.

More recently obviously the explosion in 2005 at BP Texas City followed by, that was followed by at that point OSHA's highest fine in its history of approximately $22 million for citations related to that explosion, followed in 2009 by our $87 million citations against BP Texas City, essentially for two reasons. 57 million of that was for not addressing the problems that were identified after the explosion in 2005. Approximately 30 million of that was for new essentially egregious violations that we identified at the same plant that again the company had not dealt with. In that same year, we also issued a major citation against BP, BP Husky in Toledo, in the Toledo area, again for very similar issues to those identified in Texas City and very similar issues to those related to the explosion in 2005. The explosion in 2005 and the resulting revelation that we at OSHA had not done a very comprehensive job in overseeing the safety of refineries led to our Refinery National Emphasis Program.

Let me see if I can get this to work. I have a presentation up here, most of which I am just going to submit to the record but there are a couple of slides up here I want to point out. These were the results of our Refinery NEP, which went from approximately 2007 till 2011 I believe we did the final inspections. If you look at the first – well, let's look at the first five. Those are – I think the first four are bolded but let's just take into account the first five there. Mechanical integrity, process safety information, operating procedures, process hazard analysis and management of change. Those five items, if you add them all up, if you add the column all up to the right, came to 80 percent of all the citations that we cited, all the violations that we cited during the NEP. And let me just – well, what we also found about halfway through the process, this pattern had become evident. We sent a letter out to the entire petrochemical industry telling them this is what we found, we're about halfway through, this is what we found and we're going back at it, so we're just getting out there warning you about what we're particularly going to focus on.

Much to our disappointment as we continued with the National Emphasis Program, we continued to find the exact same pattern of violations. In other words, we were I think to put it lightly, disappointed at the low level of learning that seemed to be happening in the industry. We have more recently initiated a chemical industry NEP, which is also looking at process safety hazards in the chemical industry. And I'm going to fast forward to some of the results. We are at the beginning of that but I want to fast-forward to some of the results we have had coming out of that. Again, this is from – these are the top ten standards cited. PSM, as you can see, is 60 percent, which is no surprise. But, look at this again. Count down the first five and you're finding the exact same top five violations. And if you add up the right-hand column very quickly, you again come to approximately 80 percent.

Again, this is rather disappointing to us. Again, one hopes after the refinery NEP there's been some learning finally in the refinery industry. At least if you look at the issues that we seem to be identifying most often in the chemical industry, you'll find the exact same hazards, the exact same violations and pretty much the same lack of learning in that industry as well. Now, the Chemical NEP – I'm sorry, the Refinery NEP basically inspected every refinery in the country within federal jurisdiction that was not a VPP member. Each of the 20, 21 states' plans that also cover private sector, those that have refineries within their boundaries either adopted our NEP or something similar or at least as effective as.

These were extremely resource-intensive on our part, something that we can't sustain given our level of staffing and resources. So, what we're trying to do is move into the 21st century and figure out exactly how to target, if you will, those refineries that need our attention. We have no more interest in going into refineries and spending a lot of our resources in refineries that are already doing their job well than those refineries have in having us harass them or visit them if they actually are doing their job well in terms of safety. Now, OSHA has various tools that it can currently use in order to inspect any kind of site. We obviously, first and foremost, we do random inspections. And, as I think Mr. Holmstrom pointed out, our random inspections around the country for every workplace are based on injury and illness statistics, on DART rates. This is clearly not adequate for refineries. And I'll go into that a little bit more, although it's been discussed already. Secondly, we always are mandated to respond to worker complaints. We're mandated to respond to fatalities, catastrophes – which is three or more people being hospitalized – or referrals of serious hazards. We also, as I just said, depend on worker complaints. And let me talk a little bit more about worker complaints. In order for workers to be engaged in the process, in order for them to feel free to complain to OSHA about health and safety problems that have not been addressed in their workplaces through normal procedures, they need a few things. They need information about what the problems are in that workplace, they need to know, again, what the safety conditions are.

We have a number of standards that require that information to be given to workers, including parts of the Process Safety Management Standard, which also requires information to be given to workers in the plant. Secondly, and probably more important is security. Workers need to be secure that they will not be retaliated against for reporting near misses, for reporting to OSHA for requesting an inspection. OSHA has within its law a Paragraph 11-C, which is our nondiscrimination language, which prohibits employers from discriminating against workers who exercise their rights, their health and safety rights. It's an old – our whole law is old. This is a rather old whistleblower language. There have been many laws that have been passed since then that have much better whistleblower language; nevertheless, it's what we have to live with. Another issue that we've been addressing more recently is the problem of incentive programs. And that is where workers are offered incentives – which may be a day off, it may be a pizza party, it may be a financial incentive when either usually when the unit that the worker is working in or sometimes the whole plant doesn't have any reported injuries. What we've found – not just what we've found but what congressional hearings have found, what studies have found and most recently what the Government Accountability Office has found – is that these incentive programs can discourage workers from reporting injuries and illnesses.

Given that, we have taken two actions recently. One is we notified our Voluntary Protection Program participants that any kind of incentive program that's based on injury and illness numbers will not be permissible for VPP members. Secondly, we put out a notice recently to all of our enforcement personnel saying that not only incentive programs but disciplinary programs, for example, that automatically discipline workers every time they're injured, other programs, for example, that discipline workers when a health and safety rule is violated if in fact the company is only disciplining workers who violate – I mean I'm sorry – workers who violate the program are injured, rather than all workers who

violate the program and a number of other – a number of other policies that can discourage workers from reporting either health and safety problems or from reporting injuries and illnesses.

We have notified our enforcement personnel that these could either be violations of 11-C, our nondiscrimination language, or our standard that requires reporting of all injuries and illnesses. Now, our problem as I just said is that obviously although we are taking a hard stand on anything that will discourage injuries and illnesses like incentive programs, in fact, it could be argued and it has been argued that OSHA's entire targeting program is really one big incentive game in that we do use employer reported injury and illness numbers in order to determine our priorities in terms of where we are going to go for inspections. Now, this works fairly well in many industries. It does not, as again I think Mr. Holmstrom and several others have discussed already. Injury and illness numbers, DART rates bear very little relation to a company's – a company refinery or a chemical company's ability to comply with the process Safety Management Standard.

Or should I say that DART rates are not a very good predictor of whether a company is likely to blow up the plant. I spoke over two years ago to the NPRA, which is now the American Fuel and Petrochemical Manufacturers, about this issue. We were – this speech happened to come right after the Tesoro explosion in Anacortes, Washington, which was yet another tragedy and disaster in the petrochemical industry. And I was – we were all rather upset that as soon as that explosion had happened, NPRA and other petrochemical industry associations immediately began boasting about really how the safe the industry is. And those were based on their DART rates. I spoke at the NPRA and told them very seriously, very strongly that they will not be, we will certainly not consider them a serious organization that's seriously concerned about safety if they are going to continue to boast about how safe the industry is based on their DART rates at the same time that widows children are burying their husbands and fathers.

From what I've seen, there hasn't been a whole lot of progress made in that area. There's still quite a bit of emphasis, way too much emphasis among many of these associations on injury and illness rates rather than process safety management indicators. On the other hand, we need your help, we need industry's help, we need labor's help. We don't know what those indicators are yet that would best be used to predict problems in the petrochemical industry in the process safety management companies. We need all parties to participate and to come up with some kind of indicators that would be not just useful for the companies. Obviously, that's the first priority is to have indicators that will be useful for a company to use internally to make sure that their operations are safe. But we also need indicators that can be communicated to industry, they need indicators that can be transmitted to workers and to labor organizations, to the community and community organizations, and of course, to government.

From our point-of-view, we need indicators that will help us target where to go. Again, we do not want to waste our time in refineries or in chemical plants that are doing a good job; we'd rather be going to the ones that aren't doing a good job and we need a way to get there. And, again, DART rates are not the way to get there. Now, there are of course, problems; several or which have been identified here, some have been identified in some of the industry publications. One thing that I think is very important and has been mentioned here is transparency. I think all you have to do is ask yourself the question you know will transparency, will making this information available to the public or to workers or to government lead to change. And I think where we've had experience with transparency like in TRI, I think some of the efforts in Europe, Contra Costa County, I think we have seen that, in fact, transparency can lead to change in the industry and beneficial change. We are very skeptical about concerns and complaints – that to paraphrase Jack Nicholson – the public can't handle the truth. We have not seen that.

We think with a good well-educated public it actually can handle the fact that not every incident means that they are in danger. I think what we've seen in this realm and a number of realms is that the only thing worse than having too much information is having the feeling that information is being hidden. So, when it comes to that, we will always err on the side of too much information and err on the side of transparency. Now, we also have some problems that you know again were raised earlier today. One is in order for OSHA to actually be able to use these indicators to better focus our inspections, to better target our inspections, we need indicators that will be useful for us. Somebody raised the problem, the potential problem today of having too much information. That is a potentially again a very really problem for OSHA. We have a relatively small staff. We have within our small staff is an even smaller subset that are expert in process safety management. We can't – too much information, we will just not be to analyze, it will be useless for us.

So, we need to focus, ideally, focus on a few indicators that will really give us a good indication of where we need to be. And, most importantly, where we need to be to address the top five problems that we have found in both the petrochemical industry and in the general chemical industry. You know we run into the debate, you know we're asking employers essentially to give us the information that we're going to use to go out and inspect and possibly cite them. That's always a problem. We can't really get around that. It's not something that's certainly foreign to us. Again, injury and illness numbers are self-reported. There is, there are a lot of potential problems and questions about whether that information is accurate. That's something we need to work on but, unfortunately, there's not much alternative to self-reported information. The question is what kind of information would be most useful for us. Ideally, if we could go to every plant and there was an outlet and we could just plug something in and it would give us a number, which would tell us whether to inspect or whether or not to inspect, that would be the best thing. So, if you guys can figure out some system that goes that way, we would be very happy. I'd like to conclude now by just saying that, again, this is an area that we are highly interested in, we're highly interested in working with you all on, we're highly interested in working with labor management, the community and as well as other government partners on some system that will develop indicators that again can be useful both inside the plant, useful for the public and useful for OSHA. So, thank you very much.

9.1 RAFAEL MOURE-ERASO – Introduction of Kim Nibarger

Thank you very much, Mr. Barab. I believe the last member of the panel is Mr. Kim Nibarger from the United Steelworkers of America. Mr. Nibarger.

10 KIM NIBARGER – CSB Meeting: Leading & Lagging Indicators Metrics

All right, good afternoon. Good afternoon. Thank you for allowing me to address the Board on behalf of the United Steelworkers Union regarding API Recommended Practice 754. The USW represents approximately 30,000 members who work in the US oil industry. They are comprised of over 70 refineries representing more than 20 companies. The CSB gave two recommendations to the API and the USW in their report on the BP Texas City disaster. One was to develop a standard for managing fatigue in the oil industry, the other was to develop leading/lagging metrics for the oil industry as well as what should be reported, who it should be reported to and how that reporting should be done. The committee was to use ANSI principles to develop the recommended practices; an open, balanced process using consensus. Representatives on the committee were to be from a diverse, broad-based group of stakeholders, which included industry, labor, government, the public, environmental groups and others. … Excuse me …

So, we will address the following items to explain why we feel that the process did not work as intended. While the list is not everything that did not allow the end result to be of the benefit we had hoped it would be, these address those areas we felt were most notable. Our concern that the end product would not bring the benefit to the industry that we had hoped for was our reason for dropping out of the process. We could not get our ideas incorporated into the document. One suggestion we did raise that managed to find its way into the notes to the first edition was the two-year review, rather than waiting for the five years to evaluate the data. The areas that raised the most concern for us was the criteria for what was reported; secondly, who it would be reported to and how that reporting would take place.

And, lastly, we wanted to propose a different avenue for defining metrics and determining the reporting issues. We fully expected each stakeholder to have a say. The industry is one stakeholder and one voice, labor is one stakeholder with one voice, environmental groups with one voice and so on. This way, each stakeholder has an equal voice in the process. This was our understanding going into the initial meeting. Instead, each oil industry representative was treated as a stakeholder because each business group represented had an individual stake in the process. The USW, the Chemical Workers and the Teamsters as labor representatives also had an individual vote but were obviously consistently outnumbered. We could have brought members of local unions into the meeting to vote with us but that was not our intent to game the system with numbers. The next time, industry could have increased their numbers and this would have accomplished nothing.

That was not our objective. We came to the table to have our input treated equally with all others. Instead, after some rather lengthy discussions and when we would not yield or submit on a point, a vote was called for and majority ruled. Our desire was to see meaningful metrics put in place that could be used to measure and drive safety improvements at refineries in the US and hopefully develop a practice that could be used worldwide to help drive improvements in refinery safety. Instead, the tier one and two indicators criteria make them of such a low probability event that there will not be a large enough number to measure for comparison. There will be no way of knowing if you are making the industry safer because the number of events will be so low that they will not hold any statistical value. And the opposite can be said – see how good we are doing, these are low numbers, so things are really safe. These are the leading – excuse me – these are the lagging metrics, these are the after-the-fact lesson learned metrics. The criteria for these tiers is too loosely defined to make the reporting consistent, even from site to site in the same company, let alone, having any consistency between companies.

Short of some corporate-imposed guideline, each facility can choose to report differently. You will not be able to measure performance, so for one thing, you will not know if you are tracking what you should or need to be tracking. The requirements for public reporting is left to the individual site, down to whether they want to report publicly or even to employees. Calling for a summary of events does not provide the clarity of information that will allow a comparison of sites. You will not be able to identify incidents at your site to see if you share contributors with another facility because you will not have enough information. This will not allow you to lead to improvements. The loss of primary containment was a huge point of contention between the union representatives on the committee and the management representatives.

The union representatives could not persuade the company representatives to move on this issue, despite using the CCPS definition. The union also presented information from a Shell Oil document that supported our point. A loss of primary containment, LOPC event does not mean that you have to have product outside of the pipe. Having it outside the vessel it is supposed to be contained in qualifies. When you have a demand on a safety system and it fails, then you have another and it fails, then another, the last line of defense before you have a catastrophic failure is a pressure relief device, a PRV, that release pressure in a vessel through a flare or through the blow-down system. To not count these events because the PRV worked as intended or designed is absurd.

The physical means to mitigate or contain the event, quote, is not part of the inner-layer systems; those would be basic process control systems, alarm systems or safety instrumented systems, but it is an independent, outer layer of protection. Accordingly, the physical means to mitigate or contain the event is not just another demand on safety systems as has been argued in API 754 committee meetings, but it is an indicator that inner-layer systems have failed or were inadequate to control an event. This fact undermines arguments that releases to effluent disposal systems, flares or scrubbers belong in tier three rather than tier two. The concern about transparency seem to be just that – a concern about being transparent. The reporting criteria is designed to keep all but the most obvious problems in the facility in the facility. There was more anxiety about how the company would be perceived for its reporting, as opposed to what should be reported. The lowest common denominator was used to make it seem that the facilities were operating safe because very few events would make it to the level of public reporting; thus a lack of reported public events could be construed as having a safe facility.

Here is a non-reporting example: charge pump motor failed causing motor fire and the shutdown of the entire unit, the damage estimate from the fire is greater than the $25,000 threshold for tier one, but there was no hydrocarbon released. So, you didn't have an LOPC event; therefore, the incident is not API reportable. Cost of the new motor alone is over $200,000. A feed line leak on an ISOM releases 773 pounds of hydrocarbon over 24 hours but it doesn't meet the one-hour release criteria, so it's not reportable. I didn't make these events up; they are from company event tracking reports. Neither of these made it to the level of reporting to be included on the API 754 reporting criteria.

April and May 2010, BP Texas City – and I hate to pick on poor BP Texas City – had 40 days of flaring 513 pounds of hydrocarbons but the material was routed through an effluent distraction device, the flare. It did not result in a liquid carryover or discharge to a potentially unsafe location. No onsite shelter in place was issued, no public protective measures were taken, no regulatory exposure limits were exceeded any time during the flaring. Though something went seriously wrong, this event didn't qualify as a tier one or two event and would not be reportable. How can events such as this be investigated to learn from so that the same mistake is not repeated if the industry is not being made aware of them? Other sites in the company are not getting the information and the public is not getting the information.

Here is a quote from The Gulf Oil Disaster and the Future of Offshore Drilling Report to the President: Based on this commission's multiple meetings and discussions with leading members of the oil and gas industry, however, it is clear that API's ability to serve as a reliable standard setter for drilling safety is compromised by its role as the industry's principal lobbyist and public policy advocate. Remember that for tomorrow's discussion. API 75 was in place at the time of the Deepwater Horizon failure. The API is a lobbying group for the oil industry. They should not be setting safety standards for themselves. The industry cannot be allowed to regulate itself any longer. An oil-specific regulatory agency needs to be put in place that can set standards that will be mandatory and uniform; no longer can the sites be left to govern how they do business. Guidelines are not sufficient. There needs to be single repository for standards that will demand that the industry improve safety. Employees and regulators need to have a meaningful say and the communities that surround these facilities must be aware of the hazards that exist inside and what needs to be done in case of an emergency.

So, steps going forward. A non-industry dominated group needs to develop the metrics used for the industry, review other governing agency rules for the oil industry, such as some of what will be presented by our friends tomorrow and later this afternoon, focus on leading indicators that can truly give a look at the facility to try and discover and fix problems before they become a reality, get input from community groups and environmental groups to determine the best methods to use for sharing the information and to get feedback from the communities to the company. We have argued for more industry sharing of events so that lessons can be learned from others. If you learn of an incident, you need to study it, look to see if any of the contributors exist at your site; and, then if they do, eliminate them. It doesn't do any good to share information or lessons learned if you are not going to take the time to fix the hazard.

All we get back from the industry about sharing incident investigations are fears of antitrust issues with too much information sharing. It doesn't seem to bother them or stop them from entering into any number of joint ventures we see with each other. We are tired of hearing about the OSHA 300 log numbers or the OII rates and how these indicate a safe facility; we know that they are low and our members have strived to reduce personal injury incidents. But these are not the things that are killing our members. Process safety failures are killing our members. My refinery had a 0.5 OSHA rate in 1998, and that afternoon, we killed six workers. Fires and explosions are killing people and it's time to stop. It is not okay to risk rank an individual's life against an expense to improve safety. We need a non-industry agency to govern the actions of industry, making the regulations mandatory and enforceable. We can no longer use the lowest common denominator and expect to achieve the highest results.

We don't see this happening without an agency with the authority to enforce the rules. There needs to be an NRC or an FAA to govern the oil industry. It's time to stop killing people and the environment for a profit. Thank you.

11 Questions & Answers by CSB Board, Staff and Public

11.1.1 RAFAEL MOURE-ERASO

Thank you, Mr. Nibarger. So, we're going to proceed in the same way that we proceeded this morning. I'm going to ask members of the board to have an opportunity to quiz the panel. I am going to start with Mr. Bresland.

11.1.2 JOHN BRESLAND

Thank you, Mr. Chairman. I guess an obvious question to ask Mr. Barab is what does he think of the proposed regulatory improvement change that Mr. Nibarger was suggesting. I don't want to put you on the spot here, Jordan.

11.1.3 JUSTIN BARAB

In terms, you mean in terms of coming up with an enforceable rule that would include indicators, is that what? (Yes.) We certainly think there is a need for indicators, again, both internally that the industry will follow, I mean each individual company will follow. And, of course, we need indicators in order to let us know where to go, as I said. There are a number of improvements. The process safety management standard is now 20 years old, over 20 years old. There are a number of improvements that we've identified that we would like to work on with that standard. Certainly, I think the indicators, both internal again and external, are one of those. So, we certainly would be very interested in discussing that. We would like in some point in the relatively near future again to go back and take a look at the PSM standard and look at those areas that need improvement.

As you know, however, OSHA rule making is quite a lengthy and burdensome process to say the least. And, we would also be willing to look at other processes to develop indicators that might be a little bit faster, even if they wouldn't necessarily take the shape of an OSHA regulation.

11.1.4 JOHN BRESLAND

How long does it take to write an OSHA regulation these days?

11.1.5 JUSTIN BARAB

Well, the GAO just did a study that showed seven and a half years, but I think that was probably on the short side and that they averaged all the standards I think from about 1980 and it's been getting worse and worse – or, let me put it this way, it's been getting longer and longer to issue a final standard as the years go by.

11.1.6 JOHN BRESLAND

So, no matter who wins the next election, you'll be long gone. Not that – that's kind of irrelevant.

11.1.7 JUSTIN BARAB

I may be here through the next three or four administrations, who knows.

11.1.8 JOHN BRESLAND

That's true. Yeah, sorry. I didn't – I apologize. Mister – am I pronouncing your name properly, Keim or- (Keim.)

11.1.9 JOHN BRESLAND

Mr. Keim. The API 754, is that your experience with the companies that are developing indicators now, are they specific to the actual risk at a facility or are they more generalized, sort of generalized indicators?

11.1.10 KELLY KEIM

One of the most challenging aspects of generating the 754 standard was to arrive upon an agreed scope of what process safety really attempts to drive. It's been mentioned frequently that over-reliance on personnel safety statistics and harm to persons would have missed a significant fraction of process safety events. Likewise, an over-reliance on the side of environmental harm may have shifted a focus to an area where there is already standards and requirements for reporting. In addition, we had to deal with what is the focus in terms of the facility versus, for example, transportation risk and loss of containment during transportation. So, all of those areas had to be defined. And one of the aspects mentioned was that you need those standards to be defined on a very precise manner so that it's unambiguous that organizations across many industries can apply them on a very consistent basis.

As you move lower in the pyramid, then you begin dealing with the issues of very wide variety of types of processes that are being managed. And, as difficult as it was to arrive at a normalization factor of workforce hours that includes both employees and contractor workforce hours as the normalization factor for tiers one and two, much was discussed about how could you normalize at tiers three and four, what would be the basis. And, in the end, we found that there was really very little agreement, very little history of anybody actually trying to normalize indicators at that level. And, so, rather than hold the standard for an extensive period of time in its development, it was determined that we should move forward with a good standard that drives improvement that companies can use to drive improvement as opposed to trying to artificially apply some normalization factor at those lower standards, at those lower levels. We believe that despite that, companies can use their internal performance and their trending of that internal performance at tiers three and four to drive improvement in their process safety.

11.1.11 JOHN BRESLAND

I was speaking to somebody at lunchtime who may want to talk about this but he was saying that the more useful indicators were the tier two ones because you had more of them and that you were able to get an indication of a trend from them, more easily from tier two than from the very infrequent tier one indicators.

11.1.12 KELLY KEIM

Preliminary information supports that conclusion that there are significantly more events at the tier two level. Tier two goes down to the lowest level of harm to a person that has a solid definition that is commonly used throughout all industries. So, the harm to a person, it's brought down to that lowest level that has a very standardized definition. The harm to facilities is brought down to a level that is only $2,500 worth of damage, so a very low number for a petrochemical industry to try to track. From an environmental standpoint and for those releases that did not cause one of the harms in those other two areas, those reporting thresholds are at a fairly low level. Now, it's mentioned that they're on an hourly

basis. It's the release quantity in any one worst hour. Time has to be an element of those release-reporting thresholds. It's clear that you can't just have a quantity without an element of time and an hour when you're dealing with the potential to cause harm, an acute release of what is the quantity in an hour was basically the best that we could get consensus in that regard.

11.1.13 JOHN BRESLAND

I'll turn it over to, I'll turn it back to the Chairman.

11.1.14 RAFAEL MOURE-ERASO

Thank you. Mr. Griffon.

11.1.15 MARK GRIFFON

Mr. Keim, I was wondering just to follow-up on Mr. Bresland's question on tier three/tier four indicators. Was it an issue of normalization more than – I mean I'm trying to get a sense from your presentation – are there in the refinery sector, are there sort of common indicators that most of those refineries agree upon that are the right ones to be looking at and it's just a question of normalization; or is it that they'll – they have very different indicators that they're selecting to track or to look at?

11.1.16 KELLY KEIM

The standard provided for recommended typical tier three indicators that should be applicable to almost any facility in the process industry. So, those had a broad range of applicability. However, for example, if we were talking about demands on safety systems as has been mentioned a number of times, if I have a facility that relies heavily on the operators and the operator is following procedures to control the hazards and to manage those situations, there may be very few, quote, safety systems for to be demanded upon in that facility; whereas, another facility that includes many sophisticated safety systems may have a significantly higher demand rate. But which facility is safer, one that is relying and putting the onus on the operators to respond to situations or to the facility that has many instrumented systems? It's not clear how you would compare those. For the owners, the people investigating the incidents on each of those, they can look at their performance and judge what are my trends, what is this information telling me. But if I were to try to compare two separate facilities with those generation of management systems, there would be very little ability to compare them.

11.1.17 MARK GRIFFON

And to this question, I'll pose this to both you as well as Mr. Nibarger, the question of the defined of loss of primary containment and the – I'm sort of I want to understand why the apparent deviation from what CCPS had recommended in an earlier document on this topic. It seemed – although maybe that's not your opinion – but and if it was a deviation, why did the definition get slightly changed? I'll ask both of you.

11.1.18 KELLY KEIM

I don't believe that we had a deviation from what the CCPS had earlier defined for loss of primary containment. Now, to speak specifically to pressure relief devices, they are a unique layer of protection in that they are both a protective system and when those protective devices function, they result in a release of material from one containment system into some other system, frequently to a system that is a destructive facility that either combusts or absorbs that material. So, they are unique, they are uniquely positioned among protective layers in that they stand at that – at that ground between many protective

systems, safety devices and loss of containment; and, therefore, as we examine – and this is – this was one of the things that we did benefit from having the labor organizations present and heard throughout the development of the standard. In fact, we committed to all of those things that had been defined up until the point when the labor organizations removed themselves from the committee, we didn't backtrack on any of the things that had been agreed upon. The standard had been largely developed at that point. But, one of the things that was being discussed during that time – and it was a major point of discussion and getting a lot of input in – is how to treat those devices.

And we really looked at the fact that ultimately you have to have at the top tier what are you trying to measure, what are you trying to change. And what you're trying to change is the harm to the people, the environment and the facilities. And, so, if I look at those types of devices, the demands on safety systems that are pressure relief devices, I wanted to look at those events that actually had some indication of harm. And so that's what got put into the tier one and tier two events and the other demands on safety systems, be they pressure relief devices or others that didn't cause a level of harm, those were kept at tier three. So, they are – they are reported, investigated and followed up on, those events.

11.1.19 MARK GRIFFON

Maybe Kim could react to that.

11.1.20 KIM NIBARGER

Well, yeah, it was our contention through the process, the PRV, the pressure relief system is the last line of defense. And according to the design principles of the unit, it is the thing that separates you from a catastrophic failure and a safe operation. And, so, we're glad that they work as designed in most instances. The argument for us was that if you are at the point of using that PRV, you've already had one, two or three failed safety systems; so, by not looking at those as an indicator, you are losing an opportunity to identify future problems. If that PRV is activated, you have had something that caused or allowed the pressure to deviate to a point that it should not be at. And that was our contention that you were missing a great opportunity to identify a lower level system and get it fixed before you had a catastrophic failure.

11.1.21 MARK GRIFFON

I guess from standpoint, and several have said this earlier today, you know this notion of a continuum, some things more leading and more lagging. I suppose that's obvious to all of us. In this case, I would say this to me seems more lagging. And, you know, I guess that's the spirit to which I ask this question is isn't this information that's useful to a lot of other refineries and is there – I would think these are sort of as it's described, in some cases, the last line of defense, although it might get into this severity factor, which I wanted to ask about also. But it might be a last line of defense kind of thing, a last barrier, and it almost got breached. And I would think that would be something that the larger refinery sector would be interested in knowing about in terms of lessons learned. And, therefore, I'd be inclined to want to push toward more public sharing of that information. Is there a problem with this particular type of metric in terms of the normalization of those, that indicator or-

11.1.22 KELLY KEIM

First let me mention that pressure release devices are not unique in being the last line of defense. All of the safety systems that are included in this term, "demands on safety systems," are typically the last

line of defense. So, there's nothing unique about them in that regard as being the last line of defense. The only thing that is unique about them is that – and other safety systems also include this – that they may trigger a movement of material from one process system to another. So, they're not unique in that way and likewise there is no normalization factor that can describe the number of pressure relief devices and the stability of any given process in terms of demand on those that's applicable across the broad industry. So, normalization was also a factor.

11.1.23 MARK GRIFFON

Normalization was a problem.

11.1.24 KELLY KEIM

It was also a factor. But also that they were not unique in being the last line of defense. The tier three is intended to be a measure of those challenges to that last line of defense.

11.1.25 MARK GRIFFON

And I guess at least for now the last question. The earlier document that was put out, the CCPS document. There's a couple, I mean there's a lot of similarities in the two. One thing that sort of I don't think was addressed in the same way in 754, anyway, was the severity weighting of the metrics. And can you speak to that and the committee's decision to modify that somewhat?

11.1.26 KELLY KEIM

The API 754 committee chose not to incorporate the severity index as a part of the standard. However, that's not to say that it was ignored or the potential value downplayed. It is, in fact, referenced by the standard as something that a committee or industry association may choose to examine. And, in fact, most of the organizations collecting process safety indicator information collect it in such a way that the information can be used to evaluate each incident based on that severity index.

11.1.27 MARK GRIFFON

And, why – you say it wasn't incorporated as part of the standard. Can I ask why the committee came to that. I understand that you still reference it in there.

11.1.28 KELLY KEIM

As a number of representatives have mentioned, these events for any one company are not terribly frequent. And, therefore, to take a relatively infrequent incident and apply a severity index and to say that there's a lot of learning for that, that's yet unproven. And there just hadn't been the time and use of that within representatives that brought information of that to the committee to say it is something that needs to be within the standard. It would be like saying that you know do I measure – do I measure the number of people on a plane. Each plane incident, commercial airline incident is an event that's serious, it needs to be examined of itself. Yes, they have different severity levels; the same is true for process safety incidents.

11.1.29 MARK GRIFFON

Thank you. I'll let Rafael have it.

11.1.30 RAFAEL MOURE-ERASO

Thank you. This is for Mr. Keim and for Mr. Nibarger, too. We discussed this morning about examples of really successful joint work on these specific issues of indicators at the BP Texas City operation in the last year, basically the management of BP and the top committee from the United Steelworkers have been able to develop a – I've found it a very efficient relationship to address issues and to discuss problems towards prevention. And my question is that when we are dealing not at the plant level but at a level of policy making as it is to develop guidelines, I find it regretfully – regretful that that type of way of working together cannot or was not being able to be developed in the deliberations that you had on RP 754. My question is to both of you. What do you think needs to happen or what changes could be there that could basically open the process up and allow for the adequate participation of the stakeholders that are represented, the workers in this situation? I will ask you first and I would like also for Mr. Nibarger to comment on this.

11.1.31 KELLY KEIM

The API looks forward to a broader degree, a broader diversity of stakeholder involvement when the standard gets opened next year for revision. In fact, the ANSI process has a required process for publicizing that a standard is open to seek out stakeholders who may be interested. And, in fact, there were no stakeholders that were turned away from the original 754-development committee. That is not a part of the process in terms of turning away stakeholders. But, once the stakeholder's committee was defined, then the standards for openness and consensus ensures that everybody gets a voice and that there is in fact a lot of recycle and hearing each voice and trying to find consensus positions. These things are not easy to achieve, particularly when you're dealing with a very new area for development of a standard. I think that through the part of the process that the USW and the other labor representatives were there. There was a lot of openness. You can see that in many aspects of what the standard addresses in terms of the openness, the transparency that's required for reporting process safety information at all four tiers to employees and the representatives. Those, many of those requirements were suggested and driven by the labor organization. So, it is unfortunate that they chose to pull out. We hope that in the upcoming revision, that does not happen because we're open to opportunities for improving the standard.

11.1.32 RAFAEL MOURE-ERASO

Mr. Nibarger.

11.1.33 KIM NIBARGER

We would like to see a committee possibly spearheaded by OSHA that involves industry representatives, labor representatives, regulatory representatives from OSHA and from the EPA to work together on developing some metrics indicators, possibly using examples from the HSE, from the Norway offshore group, and then invite stakeholders, environmental groups and community groups in after the fact to talk about reporting. How can we get that information to the community, how can the community get their concerns to the companies. We – there (were) nobody turned away in the community and that's – you know we wouldn't argue that. But I just – there were groups that were unable to participate and we'd like to see that process where they were able to give more input.

11.1.34 RAFAEL MOURE-ERASO

Another question. This is changing gears here. I understand that there is a API Recommended Practice Number 75 that is included in the Department of Interior proposed regulations and the

regulations of that are in place. I wonder how different is that from 754 and how do you see the concepts of 754 that we are discussing here that are useful as predictors could be integrated into API 75.

11.1.35 KELLY KEIM

I have no personal expertise in the area of API 75 and so really can't comment on that.

11.1.36 RAFAEL MOURE-ERASO

We are going to continue now, giving the opportunity to our staff to have some questions for the panel. So, you are still asking you to entertain these questions. So, anybody from the panel that would like to give some questions, please proceed.

11.1.37 DONALD HOLMSTROM

I have at least one question for each of the panelists. I appreciate the opportunity and I really appreciate all of you coming today. Thank you very much, it's a great honor to have you here. My first question is for Mr. Keim. I'm trying to understand in terms of the tier three and four indicators and the difficulty I think you addressed of normalizing and standardizing these indicators. We have talked to and we've had presentations by companies indicating they're doing, they're taking you know leading indicators and they're normalizing them and standardizing them across their company for comparisons. Was the difference, were people saying that it was impossible and general to normalize or standardize those indicators or was – in other words – were companies saying we're doing it internally but we can't agree between each company on how to do it, or was the idea or the conversation that it was just impossible to do it, period?

11.1.38 KELLY KEIM

The more common the nature of the processes and the hazards that are being managed, the greater the ability to arrive at a standardization for those tier threes. So, if a company is operating a single type of facility with a single range of hazards and the means and management systems with which they management – manage those hazards, their ability to normalize for those tier three indicators is significantly greater than a company that may have both refining as well as petrochemical as well as potentially specialty chemical operations. So the greater variety of the processes and the systems that you are using to manage those hazards, the less ability there is to find a common way to normalize those. So, it's not necessarily surprising that an individual company may be able to do it for their facilities, depending on their scope. It's more difficult and less meaning for a large company with diverse operations. And then when you try to take across the entire industry, it just there was no meaningful way to normalize.

11.1.39 DONALD HOLMSTROM

Mr. Nibarger, in the BP Texas City investigation conducted by the CSB, prior to the incident, we noted and in particular, there was a safety culture survey that was done that noted there was an incredible degree of fear amongst the workplace, that the workers felt that they were going to be punished or discouraged from reporting incidents or hazards. And it seems as if this situation has changed significantly in the wake of this incident. Can you describe for us what you think has changed because obviously it's very important that hazards, workplace events and near-miss incidents and things of that nature be encouraged to be reported in an atmosphere without any kind of recrimination or retaliation. So, could you describe that for us.

11.1.40 KIM NIBARGER

Well, I think BP Texas City in specific, their implementation of the Triangle of Prevention, the TOP program, has allowed the employees more voice when it comes to recommendations from incident investigations. I think employees are more inclined to report events that they wouldn't have been before because of the way the process works. It's not a company, you know, witch-hunt for a better word. Right. They're not out to put the blame on somebody, they are looking for root causes and hopefully addressing them. So the – I mean, the issue is on the whole indicator thing – you know, it doesn't – I mean, tracking them is one thing. The bigger part of the problem is doing something with the information once you have it. If you have a good investigation process and it uncovers three or four or five contributors, and then you don't put any system in place to correct those, what good does the investigation do? We haven't seen a new big contributor to any of the accidents we've looked at. Even, you know, for some reason we, I mean Texas City because of the number of people killed and injured gets a lot of attention.

But the events that – the recommendations that came out of Texas City for one thing, the facility citing issue with the trailers wasn't anything new. I mean, that had been identified in reports in the Avon Tosco California event. I do not recall the year now – in '95 I want to say in that neighborhood. Russellville, Pennsylvania, a facility citing was identified. And, yet, that problem continues. And we can go on and on and on for different precursors we've seen that are not being fixed. So the Texas City example of the employee involvement I think has given them the ability to see that they could make a difference. That is not the case in the industry generally. There are still lots of facilities. We had an incident not too long ago. The OSHA cited the company for a number of violations. When our employees went in to talk to the company and the OSHA representative, they did not express the same concerns. And they said afterwards they were in fear of retaliation from the company after the fact. They don't fire them tomorrow, they wait till six months down the road and then they are disciplined or fired, or you know for relatively meaningless events. So the retaliation thing for employees reporting is significant.

11.1.41 DONALD HOLMSTROM

Thank you Mr. Nibarger. Mr. Barab, you mentioned that OSHA would be supportive and could use useful process safety information but did not want to be overwhelmed with too much information, given limited staff and resources. My question for you is would it be useful for OSHA to be receiving that useful information so precisely because you could use it to target where there are specific problems for inspections, for resources, for possible future PSM rule-making in terms of knowing where the problems are or what the problem facilities are or where the industry trends and problems are. And having that information would then be useful for you to allocate those scarce resources and limited staff.

11.1.42 JORDAN BARAB

Well, yeah, yes. I mean, information is always useful, particularly for policy purposes to the extent we are looking. You know, we will hopefully some time in the future take another look at the PSM standard and decide where it needs improvement. Obviously, the more information we have there, the better. As you know, our regulatory process is – part of the lengthiness is collecting the information, analyzing the information, getting public comment on that information, and the public contributing more information. So that's always good there. Again, the problem, you know, with enforcement is just kind of trying to, you know, see the trees and not getting lost too much in the forest I guess. And the question we always ask ourselves there is, I mean, what is the minimal amount of information. I mean, this is just an

example, what's the minimal amount of information that we could have received that would have helped us make some kind of intervention that would have prevented something like Texas City. Now we don't need you know tons, overwhelming amounts of information, but we do need some key information, you know, that will give us some indication that there is a problem.

11.1.43 CHERYL MACKENZIE

Thank you. I know there's a number of us so I will start with just one question and pass it down and maybe swing back around if there is time. For Mr. Keim, you know, moving forward, if you could speak to how specifically the committee plans to go about defining tier three and tier four indicators and you know will you be integrating guidance on how you are going to trend the data that you receive from the tier four and tier three levels, in providing guidance to companies. And, before you answer, I'll point out that the annual reports of site-specific tier one, two, three and four process safety event information that will be reported to employees seems like a good, a good window into what might be prevalent issues that multiple sites are facing and could be used to find or uncover industry-wide problems. Now I'll turn it over to you.

11.1.44 KELLY KEIM

So the- in terms of reporting to the employees and their representatives the tier one, two, three and four, as you mentioned. First off, there's a lot of guidance in the API 754 for several of the tier three indicators and for a handful of suggested tier four indicators and then we point to other documents that give greater detail. However, in terms of if you are trying to get in terms of did we specify here is the reporting format; we think that the companies have good processes for doing that. They don't need to be told a specific – here is exactly how that you report this information. They are pretty good at coming up with things like that and effective tools for that.

11.1.45 CHERYL MACKENZIE

But do you think that the companies that are good at that could share those with the companies that might not be so good at doing that and to have kind of cross-industry learning on best ways, best practice?

11.1.46 KELLY KEIM

One of the tools that's already in practice for that, and I did mention that there had been many presentations – I believe at least 15 in the last little over a year – presentations by company users of RP 754 that have pointed out how they are, in fact, using the RP 754 indicators at all levels and how they are using those indicators to drive improvement. In many cases for tier three, just the fact of recognizing that those demands on safety systems, that safe operating limit exceedances, that having reports of- reports of testing of your facilities that are outside of accepted standards; recognizing that those are, in fact, indicators, those are near-misses and to treat those, that each one of them deserves some level of investigation and then to use that aggregate data. So, companies are already using it that way and are, in fact, reporting their learnings. One of the initiatives that the API has worked with the American Fuels and Petrochemical Manufacturers is to develop a joint effort advancing process safety. One of those, one of the areas in that effort is sharing the key information regarding process safety events and the learnings from those.

11.1.47 CHERYL MACKENZIE

Thank you.

11.1.48 KELLY WILSON

Moving forward in developing useful process safety leading indicators, it seems that industry workers and regulators all have different needs, knowledge and abilities. One of the most interesting examples of industry, worker and regulator groups working together was the UK Step Change group that we visited a couple of months ago where representatives came together from each of those groups and, additionally, safety representatives from offshore platforms also came together to report to each and challenge each other on areas that they needed work or development. We will be hearing more about this tomorrow. Mr. Barab, this question is primarily for you, just because I think we have heard from Mr. Keim and Mr. Nibarger somewhat on this, but if you have additional things you can also chime in. But how do you see the best path forward for developing these indicators where all three of these groups – industry, worker and regulator – can have strong voices together to contribute both their knowledge and abilities to meet both industry, workforce and regulatory needs?

11.1.49 JORDAN BARAB

Well, I think there needs to be a process where each constituency has an equal voice, or at least an equal opportunity to express that voice. You know, we do, we have a regulatory process where we have many means of public input. We have written comments, we have public hearings where anybody who wants to can come in and testify, we have an opportunity actually if you are a witness, you can actually even question the other witnesses – it's kind of a fun experience. And then we have post-hearing comments. Now, needless to say, we don't just add up all the comments on one side and weigh them with the comments on the other side and decide what's right. We actually look at the merits of each argument. So we could have, you know, two representatives presenting evidence on one side and a hundred and fifty on the other side, but if the two actually have arguments that you know can be better validated and are more based on the science that we are looking at, then that will be something that we focus on. So there needs to be, in other words, there needs to be a process that actually looks at the facts, looks at the science and doesn't just you know weigh the number of representatives on each side. It needs to have everyone, you know the concerned involved. And you know there needs to be you know, again, some process forward for reaching a conclusion in a reasonable amount of time. How that would be structured, who would lead it and everything, we are certainly open to discussion.

11.1.50 KARA KANE

Mr. Barab, I don't mean to pick on you, but Mr. Nibarger did say that we need an NRC or an FAA to regulate the oil industry. And, I don't want to put words in his mouth, but I would assume he means just a more nimble regulator, perhaps one who's a little more present with these issues. And I'm not sure what the problems are. I guess I'm just wondering if you could speak to what we, meaning collectively everyone in this room, could do to help OSHA improve getting industry to do more work on these issues.

11.1.51 JORDAN BARAB

Well, it's interesting, I mean, it's a good question. We've been, you know, talking here within the realm kind of "what is." In other words, the structure of OSHA as it exists now and with our current level of resources, and what's possible within that realm. If you look however, if you step back and look at the entire industry, both onshore and offshore, the different facets of the industry, it really makes no sense. Nobody who is starting now and told to create some kind of regulatory structure for all these industries would probably develop a system as we have it now, if you can even call it a system. I mean we have different oversight and different regulations for onshore than we have for offshore, offshore is split between a number of different agencies depending on what's being looked at. We, OSHA, have different

standards for refineries and chemical plants than we do for oil and gas in the field also doesn't make much sense if you were going back and redesigning it again. And then of course there's the overall question, I mean given the size and complexity of refineries, given the rest of the industry, given offshore, you know does the current structure even make sense? By the current structure I mean where OSHA figures out where to go and does an inspection. Because even if we figure out where to go, we can only actually focus on a small part of any given plant, or any given refinery, or large chemical plant. So maybe this is not a structure, I mean if we're really looking outside the box, maybe this isn't a structure at all that makes sense. And there have been discussions going on, there will be discussions going on, we're in discussions with a number of other agencies about – and you all have as well – about looking at whole different systems, safety case systems, or looking at different regulatory structures, looking at different structures for agencies to oversee. One idea has been having one agency oversee the whole chemical and petrochemical industry. Perhaps doing some kind of safety case rather than an inspection based model. I mean these are all things that I think are open to discuss. But I think there's a general consensus that the way we're doing it now doesn't make a whole lot of sense.

11.1.52 BILL HOYLE

Two questions. First, Mr. Keim, thank you for the precise data on the number of refineries participating in indicators programs, that's helpful. Could you also share with us how many incidents, how many tier one incidents have been reported to date, and how many tier two incidents have been reported?

11.1.53 KELLY KEIM

I'm not prepared to respond to that at this time. The API has looked at and said when we have sufficient maturity at reporting to ensure that we have in fact a level of comfort that the standard has been implemented appropriately at the members who are reporting, then we will be willing to publish that information broadly to everybody.

11.1.54 BILL HOYLE

I wasn't asking for any breakdown, just the raw total numbers, you can't speak to that?

11.1.55 KELLY KEIM

No.

11.1.56 BILL HOYLE

Ok, thank you. Mr. Barab, we have a parallel standard in this country for process safety. It's the EPA Risk Management Plan standard, and that seems like an important aspect of this conversation. It seems that EPA would have every bit as much interest and need for key performance indicators as OSHA and the industry would. Mr. Barab could you describe what mechanisms or what tools does OSHA have to work in collaboration with EPA, between the PSM program and the RMP program to advance key performance indicators.

11.1.57 JORDAN BARAB

Yeah, good question. That's actually something that we've been increasingly interested in. We've been actually have had some meetings recently with EPA to look at what kind of data they have, their ability to analyze that data, especially analyze that data for purposes we can use. Our actually how we, our targeting our chemical NEP is we're actually using EPA data on that, EPA RMP data to help us do that as well. So it's something that we are very interested in. As you know they collect a lot of

good data, they have different thresholds and things like that so it's not totally relevant to everything that we do but it's certainly a major help and they do have a lot more data and a lot more ability to analyze that data than we do.

12 Qualities of Effective Indicator Programs (Part 2): Downstream Petrochemical Refining

12.1 **Introduction of Panelists - RAFAEL MOURE-ERASO**

Having the second panel of this afternoon, we are discussing qualities of effective indicator programs and again we have this afternoon a very distinguished panel that I am pleased to introduce. We are having Mr. Ian Travers that is the Head of Chemical Industries Strategy Unit for the Hazardous Installations Directorate from the Health and Safety Executive- Health and Safety Executive of the United Kingdom. We also have Dr. Jessie Hill Roberson that is the Vice Chairman of the Defense Nuclear Facilities Safety Board. We have Mr. John W. Lubinski, who is the Deputy Director of the Division of Inspection and Regional Support of the Nuclear Regulatory Commission of the United States. And we have Mr. Martin Sedgwick, the Head of Engineering and Research and Development from Global Technical Services for Scottish Power from the United Kingdom. So, we would like to start the panel with Mr. Travers, so I'm going to ask Mr. Travers to make his presentation. Thank you very much.

13 IAN TRAVERS – The Implementation of Effective Key Performance Indicators for Major Hazard Enterprises

Mr. Chairman, board members and staff, it's a very, very great honor and privilege for you to invite me here. I'm happy to come and try to share our experience of major hazards, process safety management and where key performance indicators fit into that system in the UK. We have a 150 years of having major accidents in the UK chemical industry, so I think we've got a lot to share with the world on that experience. And we've had them all, so we have a view now there are no new accidents, there are only new people making those- having those accidents. So I think everything to play for in terms of learning and sharing how to prevent and mitigate those accidents. Our approach in the UK is not along the lines of the API guidelines.

We have a distinctly different regulatory framework in the UK, and a distinctly different approach to KPIs than in- reflected in the API guidelines. First of all, we had a plethora of safety legislation going back a hundred or so years until the 1970's. And in their wisdom our government appointed (Lord Robens) to have a look at it. And he basically said let's get rid of all of the prescription and let's have some goal-setting legislation. So we legislate on outcomes, not necessarily on the means or the process. You wouldn't guess that by the amount of guidance we have to produce to explain what outcomes and good practice is, but that is our legislative framework. And that's been reflected in the major hazards, the onshore major hazards legislation in the UK, which is European-based on the EC Services Directive. And it places one main requirement on the operators of major hazardous sites; and that is simply that they must take all necessary measures to prevent a major accident or mitigate its consequences. And, so, we are not prescriptive in how companies do that. So we don't have an OSHA standard and we don't have a code that says how to manage risk or process safety management risk. But, essentially, we approach things through James Reason's Barrier model.

I got first involved in setting key performance indicators for process safety after the BP Grangemouth incident. A colleague and I sat around with a lot of industry in Scotland and we asked one question; and, that question is how would we get to know whether this site or this plant is going to blow up tomorrow, how do we know it is safe. And we thought the answer was easy. We thought we would write a whole series of key performance indicators that everyone could sign up to. And within about a couple of months, we had 20 and they looked really good and we tried them out on industry and they said "Yeah, they're okay, but actually we do things differently in our plant or our business." So we rewrote them and we tried them again. "No, they're not quite right." And, so, we decided to stop that. What we decided to do was we decided to write HSG 254, which was a process of how to set key performance indicators. And I'm responsible for bringing James Reason and Swiss Cheese into the discussion on key performance indicators, unfortunately. However, it's a very good model and it suits our purposes in terms of how we regulate major accidents.

And we expect, probably in the same way as many other regulators, and, indeed, this just reflects the way business manages risk, that if you are trying to prevent a loss of control or a loss of containment of a major hazard, then you need protective barriers or control systems. And, as I said just before, we are not prescriptive on what they are. We leave it to the individual duty holders to work that out. And, you'll see in my diagram there that they are not all the same size; and that's meant to depict the fact that the control measures won't be at every site and every location of the same importance. They won't be the same in number, the same in type, or the same in level of importance. And so our duty holders have to work that

out. And not only do they have to work out what preventative barriers they need, they need to work out the mitigation – so the emergency shutdowns, the evacuation, fire-fighting arrangements, etc. And our job as regulators is to look at this model in the context of the businesses we're regulating and determine whether those things are appropriate. But we have a permissioning regime in the UK, both onshore and offshore, so the company has to set this out in a document submitted to us before they start operating, before they make any significant or major changes to operations, and review and refresh that every five years. So we have a constant degree of attention to these barriers.

So where do KPIs fit into this? Well, my view is KPIs are a way of getting a return on your investment. As a business, designing safety systems, putting these barriers in place, training your staff, writing procedures, and operating safely costs a good deal of money. But very little attention is then paid to whether they're any good. And that's where our thinking on outcomes comes in because for each of these preventative barriers, we encourage our businesses to think of the purpose of the barrier they have in place. What does it look like when it works well? What's success like in this particular aspect of risk control? And if you absolutely believe that these barriers are perfect and will work every time and were as good as the day that you designed them and implemented them, then you have problems because every single control measure and every barrier you have in place will be subject to some form of deterioration. And, if you're lucky, so can spot that before you get catastrophic failure; but, unfortunately, on many occasions, you don't spot that. So we believe that if you're in a major hazard business in the UK, you have to be a high reliability organization, you have to know what measures you have in place and you have to high levels of assurance that those barriers and those control measures operate as designed. And, the way to do that, as well as having a program of auditing, is to have some focus key performance indicators to show you that those barriers are still there and performing. And we would like those to be both leading and lagging indicators. And I'll say a little more about that.

So we expect companies in major hazards in the UK to be high reliable organizations; okay is not good enough if you are operating major hazard plants in the UK. But we don't see any real difference between being successful in running a major hazard plant and being successful in managing risk. In fact, if I had a lot of money invested in a plant and equipment that could blow up tomorrow, I'd really want to know that it was being controlled properly. So, business success and success in controlling major hazard risks are one and the same things in our books. And we think that KPIs are the currency of management decisions and leadership. So, if you want to have a conversation at board level about how well you are doing on process safety and control of risk and you're not having that conversation around what the information you have against the performance of those barriers and the control measures of performing, then you're making decisions about business and activities blind to the facts that are operating on every side. So KPIs are the currency of leadership and management and decision-making in organizations. And, that's a bit of a naïve view, I guess because most senior managers and chief execs that I get to meet in major hazard businesses have an over-optimistic view of these arrangements. They have no sense of vulnerability in terms of them deteriorating. The first comment I always get when we investigate a major accident is, "It shouldn't have happened. We have a system or a procedure that should have prevented that. It must be down to operator error." And the reality as you will probably gather from your work is that it is very rarely the case; that there have been signs and symptoms of deterioration available to the organization before a major accident. Senior managers and executives are over-reliant on technical experts. They absolutely believe what they've been told; but they don't speak the same language as those experts. We have guys who can speak in numbers of 10 to the -6 in terms of risk and a (INAUDIBLE) which as low as reasonably practical, etc., etc., to finance managers who are making decisions on investments. And, so, the two don't talk the same language. But the language and the dialogue is difficult

because good news is welcome, but bad news never is. So, how can you have a dialogue about the performance of the critical barriers and critical measures to safeguard the plant and equipment without some degree of honesty and openness in that dialogue. And, indeed, we find, probably as you do, that people are rewarded for reporting success, they are rewarded for finding workarounds, and often the people who do the workarounds are not best placed to come to some view or judgment about their own competence. So, I think there is a conflict in the way that process safety management is actually given effect in most businesses. And, KPIs and information flows and discussions about the adequacy of those measures and where they are going wrong are a way of cutting through that difficulty. So, that's why we think they really are the currency of major hazard risk control.

We've done a lot of work on sector versus organization versus site-based KPIs and we've come down very firmly to the view that the best KPIs are those that are based around the actual activities undertaken. If the KPIs don't measure these barriers, then you'll never know whether you're managing risk or not, and there's no short-cut answer to that. There's a lot of confounding discussion in the process but these are the things that prevent major accidents. So, if you're not measuring how well you're looking after your containment, then you are kidding yourselves in terms of whether those risks are being adequately controlled. So, instead of using the terms "loss of containment," etc., when it comes to measuring process safety, we use the term "adverse outcome." Are you getting the outcome that you wanted from that control measure? So, if you have got a permit to work, system is one of those barriers; do you all understand what our firm is about, do you all understand what it looks like when it works, do you all understand the signs and symptoms of that when it starts to go wrong? I spent six hours in a refinery with seven or eight guys who are responsible for a permit to work a system, and it took them six hours between them to agree why they had one and what success looked like when it worked. So, you've got to have those discussions. You've got to all agree why that system is there, what it does, what it delivers, what it looks like when it works; and, when it doesn't work, when you get an outcome you that don't plan or anticipate, that's a valuable piece of information. And we call that a lagging indicator. Okay. We spent a lot of time in the UK looking at Buncefield overfilling gasoline tanks. What would be the leading indicator in that sense every time you overfilled the gasoline tank?

And that doesn't mean every time you overfilled it to the higher-level alarm rang or overfilled it till the safety device cutout because those things often don't work on demand. That means when you put more fluid in that tank than you intended, you didn't intend to put more in, that was a system that had gone wrong; that is a piece of information that is gold dust in terms of managing risk. So adverse outcomes or outcomes that you don't plan to have as a result of having these barriers in place are lagging indicators in our terminology. Leading indicators – and I wish we didn't use the language – in fact, we call them outcome indicators and activity indicators. But leading indicators are the things that must go right every time within that system to deliver the desired outcome. And – sorry, that's just for those of you who like bow ties, it's just a different way of organizing the barriers. Each of those barriers, whatever they are, will contain three elements – about the people who are doing the work and their knowledge and understanding, what the plant and- the condition of the plant, and what the process that's being undertaken. So it's no good just measuring one of the three things in each barrier.
You need to look at how people work, you need to look at how the plant is designed to give effective, safe operation; and you need to look at the processes that underpin that safety outcome. And we approach this, this model by starting with any plant or any business when we look at the activities undertaken on the site and we map the challenges to integrity.

So we map the things that can give rise to, in our case, loss of containment of chemicals or dangerous substances. And those generally are always pretty much the same, but they do differ in strength and importance site to site. So we're looking at measuring challenges to the integrity of the plant that keeps the hazardous material inside. And, anything that challenges that integrity that you can get information on in terms of understanding why the control measure didn't operate is valuable information. When Andrew Hopkins chatted to me before he wrote his paper on leading and lagging indicators I just said to him, "Look Andrew, if everyone spent the time they spend trying to work out whether something is a leading or a lagging indicator in actually focusing on what information they have and acting on it, the chemical industry would be a lot safer."

So, although it doesn't matter whether things are leading or lagging, and I don't think it does, it is important that people agree what success looks like in these control measures, what success looks like in managing the challenges to integrity. So the critical characteristics of KPIs for us is first of all, they reflect a consensus of those involved in the activities on the site to what the critical- what the measures are, which are the most critical to prevent a major accident. So they have to be tailored to the risk. So we have this concept of risk profile which is based on not just the hazard identification – what you've got, how much you've got, what's its condition, but also and what processes and activities – but what can go wrong, what are the challenges to integrity, what are the consequences, what are the probability, and that risk profile determines the nature and measure of the those barriers you have in place. And if everyone on-site doesn't have that picture in their mind of what's important, why it's important and the fact that it is protecting them and their colleagues from major accidents, then you need to have more dialogue and discussion. The measures – you can't measure everything, although some people try – and measuring isn't anything without acting on the information. But you need to you need to focus on vulnerability. So, if you're going to measure things, you measure on where you're vulnerable, measure where things are going to go wrong quickly, going to go wrong without giving you advance warning, and going to give you no opportunity of recovering. And we are working on a revision of 254 that builds that vulnerability model into our guidance.

You should really use KPIs on existing data and systems. Never worked with a company yet that had to invent a set of data or information flow to measure their key performance indicators. Companies are awash with information. But what really counts is the time and effort that goes into doing that analysis. I've worked with very, very many companies in setting KPIs and I think I can count on one hand the number of times we've been able to do that without stopping the process and working out – actually we're trying to measure something but the system doesn't exist, so we better go and put the system in and then we'll measure it. And, so, the process of setting KPIs is just as beneficial as the measuring. In fact, often it's more. And people often say that actually what we'll do is we will review these every three or five years because we do hazard reviews and that's a very, very good way to look at whether we got the right measures. But they need to be very clearly defined so we're all talking about the same thing, and we need to understand why, or companies need to understand why that measure is important. So, workforce involvement, involvement of the people involved in doing the work is so crucial. I'm going to finish off now just by trying to give some insight into what our expectations of duty holders are, beyond having these measures in place.

We expect all major hazard companies to have key performance indicators. We expect them to be leading and lagging in way. We are open to discussion about whether things are leading and lagging. But if they are measuring things not associated with the control of containment and they are not measuring challenges to integrity, we tell them that they are measuring in the wrong place and so they are not giving

us a high level of assurance that they are measuring the right things. So, we expect companies to have measures in place, we expect them to be tailored to the risk, but, most importantly, we expect to see evidence within that organization of how that information is used. Who gets to see it, who acts on it, who makes the decisions, how does that change the control of risk. So, measuring doesn't achieve anything; it makes lots of people feel comfortable that their measuring and are busy, but, actually, it is acting on the information that really, really counts. So we will look for very clear evidence in companies of how that information is used. Thank you.

13.1 **RAFAEL MOURE-ERASO – Introduction of Panelist**
Thank you. Thank you very much. Our next panelist is Dr. Roberson. So please.

14 JESSIE ROBERSON - Using Indicators to Avoid Major Accidents

Good afternoon. I am Jessie Roberson and I am the Vice Chair of the United States Defense Nuclear Facility Safety Board. My agency is an independent establishment within the Executive Branch of the US Government. We are tasked with providing independent safety oversight of defense nuclear facilities operated by the Department of Energy. My agency has spent an extensive amount of effort studying the history and nature of major accidents, the application of performance metrics and leading indicators, and the role organizational culture plays in the safety of high-risk operations. I'd like to express my appreciation to the chairman, other members of the board and the board staff for the opportunity to speak with you about what we've learned and how we're using that information. I've submitted a written statement for the record. Rather than reading that here, I would like to summarize those comments and then highlight a few specific points.

It has been observed that major accidents are usually characterized by the coincidental breakdown of multiple barriers rather than the sequential progression of precursor events. The initiating event may be fairly minor but as the successive barriers fail, the resultant accident continues to grow in significance and consequence. The organization quickly becomes overwhelmed by the unfolding catastrophe and is unable to regain control of the situation. Accident theorists model this situation as an unfortunate alignment of the performance variability of the individual barriers. These variations may be due to design or construction deficiencies, inadequate maintenance, production pressures, or inadequately prepared operators. In the end, all high-risk operations are performed within the range of performance represented by the sum of the elements. In evaluating these performance variations, one cannot assume that the various barriers are completely independent of each other. For example, a company facing financial challenges is probably postponing preventive maintenance, and taking shortcuts on operating procedures, and using untested and riskier technologies, and so on. One of the most interesting aspects we have observed in major accidents is that essentially all of these accidents occurred when the organization was under significant stress.

The stresses are usually generated by conditions outside the organization's control, such as fluctuating product demand, market instability, hostile takeovers, corporate mergers, public distrust, or conflicting priorities. While all organizations encounter these types of stresses periodically, in these cases, the stresses were sufficient to challenge the organization's wellbeing. We believe what happens is that the organization's members become distracted by the stress, they change their priorities, they take shortcuts in the work, they delay maintenance, they accept lower standards, and they condone riskier behavior. In other words, the higher stress levels impacted multiple barriers and created serious accident-prone situations. Clearly, safety in this environment is achieved by minimizing the variation in each of the barriers relied upon to assure safety. All barriers, regardless of whether they are physical components, computers, procedures, or operators, must be capable of performing their functions whenever necessary.

A leading indicator program, first and foremost, must monitor and understand the functionality of these barriers and the collective priorities of the organization. We believe it is incorrect to assume that leading indicators predict future accidents. There is not way to identify a metric that can reliably predict a future outcome. I wouldn't even try. Instead, the goal must be to minimize accident-prone situations, those that can be predicted fairly reliably. Conditions such as untested barriers, poorly maintained equipment, inadequate procedures, unqualified staff, uncontrolled hazards, or ill-prepared supervisors are widely recognized harbingers of accidents. The situation- The situation gets even worse if several of these conditions are present at the same time. That is why the focus of the leading indicator program should be

on the functionality of elements relied on to assure safe operating conditions. Those elements are people, processes and equipment, things that can be readily monitored. So how does one identify a leading indicator?

One of the things we noted about studies on leading indicators is that they offer many candidates for metrics, but they rarely offer a process for designing a leading indicator program. In my written statement I have described a five-step process that we believe forms the foundation for an effective leading indicator program. The process is goal-based and functions by comparing safety-related metrics to production-related metrics. An organization will find that it is probably already collecting the data necessary for this program. By following the process, the organization will review that data in new and more informative ways. To start, the process facilities identity of the key barriers and functions that the organization is relying on to afford- to avoid major accidents. Then it guides the selection of the appropriate metrics to monitor those barriers and functions. Finally, the process monitors the organization's balance and priorities; i.e., organizational decision-making, between production and safety by tracking and trending relationships between production-related metrics and safety-related metrics. We believe that looking at metrics and leading indicators- We believe that when looking at metrics and leading indicators, context is everything. The absolute value of a metric rarely conveys sufficient meaning from which one can draw a conclusion. A negative trend in a single metric may be significant or it may just be seasonal fluctuation. Instead, only when the metric is normalized and placed into the proper context with other metrics can one recognize the significance of the value. By monitoring both production-related metrics and safety-related metrics in a logical and consistent manner, and looking at the trends holistically, we believe our approach captures the context within which the metrics are changing.

Now, let me draw your attention to two important aspects of any leading indicator program. First, we often observe metrics being used inappropriately. The strength of a leading indicator is in how closely it relates to the barrier or function that it is monitoring. This linkage must be clear and logical or else the organization can deceive itself into believing that conditions are different than they really are. One of my favorite examples is – and many have said it today – it's the use of personal safety metrics to infer that an organization has a good nuclear process safety posture. These metrics may indicate the presence of a good personal safety program, but they indicate nothing about the quality of a nuclear process safety program. Second, leading indicator programs are intended to be used. They are tools for managing the organization and its operations. They are not good tools for impressing auditors. There must be assurance that the metrics are valid and timely. Senior managers must be directly involved in the process and they must be ready to act quickly and decisively when trends are detected that are outside the defined, preferred operating range.

The results must be available to managers at all level of the organization and people must be held accountable for generating the data and acting on the results. The program will help an organization avoid major accidents, but only to the extent that it is accepted and used. What we are really talking here is a method for monitoring the collective decisions that the organization is making. Are the decisions conservatively biased toward safety? Are the safety resources adequate to support the operation? Are the key barriers receiving proper attention? Are the people trained and qualified for their assignment? Is the organization prepared for the unexpected? Major accidents all have at least one thing in common. If you take a look at Titanic, Apollo I, Forrestal, Three Mile Island, Bhopal, Challenger, Chernobyl, Pacific Ranger, Value Jet Flight 592, Colombia, Texas City, Fukashima, and others, in every case what you see is an organization that was blindsided by a sequence of events that it did not anticipate and was not prepared for.

Afterward, we can see the sequence of events that led to the accident, but we could not predict that sequence in advance. But we also can see the development of the accident-prone conditions. The organization was accepting an increasing level of unmanaged risk. Those conditions could have been monitored, allowing managers to recognize and promptly act on the conditions prior to the onset of the accident. We can, and must, improve our recognition and correction of accident-prone situations if we are to continue to make progress in a world of more complex and riskier technology. We believe that a properly designed leading indicator program will allow us to do that. In closing, I would like to thank you again for the opportunity to contribute to this hearing. Whether the nature of the accident is chemical, nuclear, biological, human frailty or natural phenomenon, we all have a common interest in ensuring that the public, the environment and the workers are afforded the best protection we can provide. Thank you.

14.1 RAFAEL MOURE-ERASO – Introduction of Panelist

Thank you, Dr. Roberson. Our next panelist is Mr. John W. Lubinski from the NRC. Mr. Lubinski.

15 JOHN LUBINSKI – Reactor Oversight Process – Performance Indicator Program

Good afternoon. I'm John Lubinski with the US Nuclear Regulatory Commission, NRC, and I want to thank the Board and the Panel for inviting me today. This afternoon I would like to discuss some background on how NRC provides assurance of reactor safety, how NRC inspects and assesses licensee performance, and the indicators NRC uses to assess performance. The NRC is an independent federal agency. Its mission is to regulate the nation's civilian use of byproduct material, source and special nuclear materials in order to protect the public health and safety, to promote common defense and security, and to protect the environment. The agency regulates civilian nuclear plants, other nuclear facilities, and other uses of materials. However, this afternoon I will focus my discussion on the nuclear power plants.

The NRC has two strategic goals. The first is to ensure adequate protection of public health and safety in the environment. And the second is to ensure adequate protection in the secure use and management of radioactive materials. The slide lists the strategic outcomes that support the strategic safety goal that I mentioned earlier. NRC fulfills its mission and accomplishes its goals through implementation of five principal regulatory functions: the development of regulations and guidance, which includes reporting requirements; issuance of licenses and certification for the construction, use and operation and decommissioning of plants; we inspect and assess operations and performance; we evaluate operational experience of licensees and activities; and we conduct research and obtain independent reviews to support regulatory decisions. I will focus this afternoon on the inspection and assessment portion of these regulatory functions.

A major component of the NRC's nuclear reactor performance assessment is the Reactor Oversight Program. This slide shows the oversight program regulatory framework; what it measures and assesses, starting with the ultimate goal of upholding NRC's mission. It is divided into three strategic performance areas – the reactor safety, which is avoiding accidents and reducing the consequences of accidents if they do occur; radiation safety for plant workers and the public; and protection of the plant against security threats. The reactor safety area is comprised of four cornerstones. These are the basic performance attributes. The first is the initiating events, which the objective is to limit the frequency of the initiating events; mitigating systems which has the objective to ensure the availability, reliability and capability of mitigating systems to reduce the consequences of any events; barrier integrity, which its objective is to ensure that the integrity of the fuel clouding, reactor cooling system, and containment boundaries is ensured – and I'll talk about that on the next slide a little more; emergency preparedness, which is to ensure the adequacy of the plant to respond and have appropriate emergency preparedness as well as response functions if an event were to occur. Under the radiation safety there are two cornerstones. One is for occupational radiation safety, which is protection of plant workers from radiation exposure, and the second is public radiation safety, which is to protect the public from radiation exposure. And, then, finally, is our security cornerstone, which is to provide assurance that the physical protection system can protect against security threats.

Satisfactory licensee performance in the cornerstones provides reasonable assurance of safe facility operation. Performance is measured through both inspection of key attributes in these cornerstones and assessment against performance indicators. Defense-in-depth is a key element of the NRC safety philosophy that employs multiple layers of protection to prevent accidents or lessen the effects of damage if a malfunction or accident occurs in a nuclear facility. The philosophy ensures that the safety will not be wholly dependent on any single element of design, construction, maintenance, or operation of the facility. A primary example of the defense-in-depth is the concept demonstrated on this slide. The first protection

barrier listed as number one is the ceramic fuel and clouding itself, which is the primary containment for the radioactive material. Second is the reactor vessel and piping that contains the cooling water and radioactive material if fuel damage were to occur. And then the third is the containment structure, the outer dome, which retains the radioactive material if there is a failure of the first two barriers.

The Reactor Oversight Program is NRC's program to inspect, measure and assess the safety performance of nuclear power plants and to respond to any decline in performance. The program's purpose is to maintain safety and uses indicative measures of performance rather than predictive measures. The goals of the Reactor Oversight Program are to be more risk informed, objective, predictable, understandable and to support being open and transparent. It incorporates risk-informed oversight to focus resources on more safety significant issues. The inspection program includes baseline inspections common to all nuclear plants. The baseline inspection program based on each cornerstone area focuses on the activities and systems that are the most risk significant. That is, those activities and systems that have a potential to trigger an accident, can mitigate the effects of an accident, or increase the consequences of a possible accident.

Inspections beyond the baseline will be performed at plants with performance below established thresholds as assessed through information gained through both NRC inspections as well as the performance indicators. Another assessment tool is the assessment of predetermined performance indicators. The submittal of performance indicator data is a voluntary program. Facilities are not required to provide this data to the NRC; however, all nuclear power plants have committed to do so. The Nuclear Energy Institute, which is an industry policy organization, developed a document containing guidance for collecting and submitting this performance indicator data and NRC endorsed this document. This arrangement was agreed upon to encourage the industry acceptance of and participation in this voluntary performance indicator program. Although the submission of performance indicator information is voluntary, NRC requires that this information be complete and accurate. So it is subject to enforcement action if it fails to be provided or is incomplete.

Because we rely on the performance indicators as part of our assessment program, we perform independent inspections to verify the accuracy of the data. If we lose confidence in the licensee's ability to report the accurate data or if the licensee refuses to provide the data, we have a procedure to independently gather this data as well.

This diagram shows that for each cornerstone we use both inspection results and performance indicators, both of which are measured against pre-established thresholds to determine their significance, and that those results are fed into what we call an action matrix – depicted on this slide as the assessment. And that's our decision-making tool on what our regulatory response would be. And that regulatory response is typically in the form of increased inspection as well as an identification of which areas in which to perform those inspections.

The NRC performs inspections to determine whether licensees are meeting NRC requirements and industry standards. As I mentioned, there are baseline as well as follow-up inspections. When licensees are not meeting our requirements, the findings or performance deficiencies are identified and licensees are required to take corrective actions. The inspection findings are then translated into a color, which is depicted on this slide, so that their safety significance can be assessed. Green findings indicate a very low safety significance. And then you work your way up in safety significance through white, and then yellow, and then red. The basis that we have for the safety significance is what we call a change in the core damage frequency. If we end up having, based on our risk informed knowledge, that whatever the

performance deficiency was or the violation would increase the frequency of core damage that would get a higher significance in our eyes. We do recognize that there is a nominal level of risk assumed with the operation of all nuclear power plants and we are interested in understanding the relative increase in risk associated with the findings or performance deficiencies. If we have green inspection findings, we allow for the licensee to take initiative to correct those issues before we increase any regulatory involvement. However, when we get to the white, yellow and red findings, there is a greater degree of significance and we increase proportionally the level of NRC involvement in oversight.

Performance indicators are another input to the action matrix. Performance indicators are plant-specific data on operational occurrences and parameters. For example, unplanned shutdowns, reactor coolant system leakage, equipment availability and reliability, emergency preparedness, drill performance, and radiological protection occurrences. Each cornerstone has at least one performance indicator as indicated on this slide in the green box. Performance indicators monitor, trend and measure performance of cornerstone key attributes. The performance indicators are used to complement the inspection program and provides. This slide shows the current suite of performance indicators for each cornerstone. We've talked a lot this morning about lagging versus leading indicators. When we look at these, we would consider these lagging indicators, but they are also lagging of precursor events. We note that most of the performance indicators are below the regulatory requirements that are to be met and even below the reporting requirements- immediate reporting requirements, and therefore just reported to us on a quarterly basis.

Similar to the inspection findings, performance indicator data are evaluated against predetermined thresholds and performance bands to establish the significance of each performance indicator. This helps NRC determine the appropriate regulatory response. The results are then expressed as colors as with the inspection findings to communicate significance easily to the public and to compare the data to the findings. Green indicates performance is at an expected level and that cornerstone objectives are met. NRC won't take additional action with respect to green performance indicators. However, licensees are still required to correct any issues that are identified, even with a green performance indicator. White, yellow or red indicators reflect increasing safety significance of the performance indicators for which NRC will take additional actions. We note that some of the performance indicators are risk-informed and others are deterministic. I will note here that for some of the deterministic – one is unplanned shutdowns of plants referred to as SCRAMS – we note that has an effect both on safety as well as production. If a plant is shutdown when unintended, that impacts production and plants don't want that to occur. However, it also puts an unnecessary challenge on the safety systems of the plant. So, therefore, avoiding those unplanned shutdowns is important to both safety and operations. We note that that is a deterministic level where we historically developed a baseline for those numbers. Others, such as the mitigated systems, depend on the availability and reliability of equipment. We then look at that from a probabilistic risk-informed standpoint. How likely would it be that the system would be challenged if there were an event to occur.

This slide shows an example of an initiating event, a cornerstone performance indicator, which is the number of unplanned scrams, which are referred to as shutdowns on this plant. We normalize this over one year, that's four quarters. We look at 7,000 hours of operation as being about 80 percent capacity over a full year. So each plant of a 104 reactors has the same metric, the same indicators. So they are normalized over all plants. As you can see in this diagram, it's colored, the green is at the top, this plant was in the green band, which 3 is the number. And you can see it went to 2.8 in the second quarter of 2011. And now it's dropped to the white band in the third quarter of 2011. The data is at the bottom. I will note that for each plant all of these performance indicators are public information. When information- the

data you see here can be obtained directly from our website and we show the plants in a matrix. I'll just hold up an example here that looks like this. This is just a printout from our website that has a matrix of each plant as well as the performance indicator column in the immediate color and if you clicked on one of the boxes, you would get the more detailed information. Every plan is evaluated for its overall performance rating based on inputs from performance indicators and inspection results in accordance with our assessment program. The evaluation is accomplished through annual review meetings. The action matrix is used to characterize the level of performance and it tells us how the plant is performing and what regulatory response needs to be taken.

There are several types of performance review meetings. Continuous reviews are done from the standpoint of the inspections. Quarterly performance indicator data is submitted and provided and the action matrix is updated. And we have what we call mid-year and end-of-year cycle meetings where we look at a one-year look-back of how the plant has performed. We also look once a year at the agency level across all plants to identify any lessons learned for the plants and for NRC with respect to our oversight process and whether changes are needed. This slide shows the concept of the action matrix. The action matrix has five columns with column one being the best column for a plant to be in because they are in their own response, five being the worst. As plant's performance degrade, the plant moves to the right in the action matrix to column two, three, four. Moving to the right means increased safety significance of the issues, increased NRC inspection, increased management involvement on the part of NRC and the licensee, as well as increased regulatory actions.

This slide is the actual action matrix that talks about how we respond. It's a bit of an eye chart, but you do have copies of it and I'll just talk in general. The top titles are the titles of the columns that were on the last slide. The first row are the results. This is a prescriptive way of looking at how many findings you need. And I'll use an example of the second column here. In column two, if you have one white input or two white inputs in different cornerstones, you'd be moved into the regulatory response column. Column three, from a results standpoint, you could have one degraded cornerstone, which means you have multiple whites in the same column or three whites in any of the columns in that strategic performance area.

The next row talks about the regulatory response that would take place. It talks about regulatory performance meetings, what licensee actions are expected, as well as what NRC inspections are in response. And, then, finally, the last row talks about the communications that would take place, what internal communications would take place within our agency as well as with the public in moving forward. I note the last column, which is listed as IMC 350 Process, is not a column of the action matrix but it's here for information. If a plant performance has degraded to the point where we do not believe that the action matrix and its response is appropriate for the plant, we can move a plant out of the routine oversight process and put them into a special O350 process. As of today, there is one plant that is currently in that process, but it has been ten years since the plant has been in that process.

For reference, my final slide has a list of references that I used today and I look forward to any questions you may have. Thank you.

15.1 RAFAEL MOURE-ERASO – Introduction of Panelist

Thank you, Mr. Lubinski. Our last panel member is Mr. Martin Sedgwick from – excuse me – the Head of Engineering and Research and Development for Global Technical Services in the United Kingdom. So, Mr. Sedgwick, please.

16 MARTIN SEDGWICK – The Implementation of Effective Key Performance Indicators to Manage Major Hazard Risks

Thank you, Mr. Chairman, Members of the CSB Board, and CSB staff. It is as Ian said, an honor to be invited from Scotland today to be with you all. So, thank you for that. What I'm going to cover today is actually how we practically implement process safety programs because it is fine talking about the indicators but actually somebody has to either measure them, do the work or make the culture change in the control room or in the maintenance team. And that's really what performance indicators are there to do. Just a little bit about the company I work for. Scottish Power is part of the Iberdrola Group. We are the fifth largest generator, electricity and gas retailer in the world, we're the largest wind generation company. We operate mainly in Europe, North and South America. But, actually, we have assets in 40 countries. In the USA, we're the second largest wind generation company. We currently have over 4,000 megawatts of wind, onshore wind, and 24,000 under construction at the moment. We're also the third largest player in gas storage and we have a major hub in Houston. And we also operate the gas and electricity distribution systems in parts of New York and Maine.

In terms of our process safety program, we started back in 2008. We were prompted by the Texas City incident, the CSB's recommendations in the Baker Panel. And we recognized that whilst we were not in the oil and gas sector as a power generator, we also had major hazards and we thought we could learn from other industries and use process safety as a major improvement program for the business. The conclusion we actually came to was that process safety, and in particular, process safety indicators are about making signs visible as we do in general health and safety. So, when we walk around an oil refinery, if someone is not wearing a hard hat, it's very easy to see. If someone doesn't have gloves, if they don't have the right equipment, it's visible. But the problem with process safety and process safety indicators, they're not visible to the organization. So, for example, can any organization or anybody representing an organization today say right now how many control loops are on manual in their asset, how many protection systems are overridden, what's the current status of the fire system.

And the concept we used here was to actually use the safety signs. And this was part of the training for the staff. And to say if you went into a control room and there was a big safety sign that said protection systems are overridden, would you do something about it, because if somebody wasn't wearing a hard hat, you actually would say stop what you're doing, let's get a hard hat on. And these types of tools and techniques are the way we used to engage the workforce. We started the program in 2008 and by 2010, we were complete and we had the whole program up and running. And we actually became a case study for the Health and Safety Executive in the UK in the approach that we had taken. And there's some case studies outside if anyone wants to take them. The principle we applied, we looked at HSG 254 and API 754, both well covered today, and also the CCPS 20 Element model. And we concluded actually they were all these bodies or regulators were absolutely right, they were absolutely right in what they were saying. The issue for us was how do you practically implement this into a sustainable program that is relevant for the workforce right up the CEO. And it's just not an initiative that's done today, it actually drives and runs the business, and, in particular, it makes a business more efficient. So, for us, process safety is not just about safety of the workforce, which obviously it is, it's about running the business efficiently and effectively.

And, again, we find the concept of process safety in business are overlooked and what I am going to explain is how we actually developed the model based on the guidance. We carried out detailed hazard

analysis of our assets. And, by the way, we have a cross-section of assets – nuclear, coal, gas, onshore wind, offshore wind, high drill pump storage. And we were told at the time that all these plants are different, they are actually not. You can apply the same principles across any assets because when you do hazard analysis, you tend to find that you have the same hazards and the same hazardous events. And we developed a risk model, because as Ian said, not all the hazards are the same risk. And, using the plant process people, we developed a hundred plus leading indicators, and in terms of lagging indicators, our approach was if it's a dent or a hole in the barrier, it's a lagging indicator.

We needed to keep it simple for the staff. It may be okay for us to understand, but it's actually the workforce that actually either report near misses or need to take action to prevent an accident or an incident. And we actually came up with a process safety model based on eight risk control areas that we thought the workforce could understand. The workforce understands operations, it understands maintenance and it understands alarm control and instrument management. And what you see on there are 42 elements and the concept was to make that visible to the organization every day, updated every 24 hours. For us, monthly reports or three month reporting will not prevent an accident. By the time you've studied the results, the accident has happened or there are so many barriers down that something will happen. We recognized that actually to make this a real, living, breathing process, it had to be automated.

And we worked together with a company called the Amor Group and IT Company. And we developed a live model, which we'll come to that. The workforce has access, also the contractors and the user every day to drive the business. And we've actually rolled this out to many other companies, not just our own and it's very transferable and in our case and other companies, within three months, we can live data going to all staff and up to the board to take action. You don't have to wait two years; you can roll this out now. In terms of developing the indicators, we used a cross-section of the workforce, it was a joint effort between the trade unions, the workforce staff, the management and the CEO. Everybody in the company's personal objectives are linked to the KPIs in process safety as well as general health and safety. So, for example, a plant operator has to do a handover. We've automated that process but actually we measure that person against handover as well. In terms of lagging indicators, we developed some concepts based on the API guidance and it was said earlier there are other industries that use this guidance, what we have.

But our focus is on the lower tier or the third tier minor. And, just some statistics. I think last year at one of our largest plants, in terms of major, we had zero, in terms of significant, we had seven, and in terms of minor, we had 195. So, we've got a lot of statistics in the minor, which is relief valve lifting a control loop on manual. And the diagram showing three triangles, that's open to the workforce every day. We show the health and safety triangle, performance process safety, and we've adopted the same approach for environmental incidents. Fully visible to the organization every day. We train the workforce, we develop the model and we wanted to make the indicator process a Swiss Cheese. We sell it to the workforce, it's Swiss Cheese. And then we didn't want to create spreadsheets the staff couldn't see and we didn't want it to be in any other format other than the Swiss Cheese model, which is on the outer ring, is the thickness of the Swiss Cheese and on the inner rings is the dents, the holes and the barriers. And I'll explain in more detail. But basically the top diagram there is part of the training manual for the staff that explains the Swiss cheese and the barriers and then it shows how it links to our KPI management system, which is live every day.

The other concept we learned was and has been said, that not all indicators are equal. If you want to consider predicting an incident or in reality prevent an incident, actually, it's operational control

indicators. And there are three types of indicators: program, generic, and operational control. Program indicators, audits on plan, action closure, procedures up-to-date. If you go to generic, it's overall maintenance backlog, for example. But, actually, the initiating event of all process safety incidents are in the operational control area, your control loops on manual, are your protection systems available, are your fire pumps ready, fully proven and tested, are your safety critical systems available, are all your vital instrumentation working right now. Are you running the plant outside its design limit, breach of limiting condition, for example, those are actually the initiating events and if you measure generic and program indicators which are much easier to actually measure, you won't prevent an accident.

Yes, the generic and program set the culture and tone for the organization but if you don't know that a protection system is being switched out on a tank, as for example, at Buncefield, it doesn't really matter what you measure in terms of program, it doesn't matter whether your procedures are up-to-date because if the staff don't follow them, it won't matter. So, in the end, our focus is on operational control indicators. Fundamentally, we risk rank all the KPIs and produce top- top risk reports, which go to the CEO. And when I say, "Go to the CEO," remember this is a live system and when you log into our intranet, it automatically comes up. When you log on in the morning on your computer, you have no choice, this is in your face – what is the current condition of our key barriers. The other area that we've now developed is a hazard report. Ian covered the Bow Tie. Well, now we have the bow ties live. In the end, it's about the hazards and the current status of the barriers in terms of preventative and mitigation; so, why not look at the process safety performance indicators in terms of the hazards that you're trying to manage.

Keep it simple. And that works so that particular example there is loss of containment of an actual gas pipeline. And we put a number of barriers in place such as corrosion inspection, pressure relief valves being tested, operators being trained and competent. And mitigation is, for example, gas detection systems available. Why not show that in that format because actually that's the language we talk about – hazards mitigation and prevention. We also did some analysis and again these are training pamphlets for our staff. And we said well, let's look at Texas City in terms of our indicators and would BP have done anything about it if they knew that control loops were often left on manual, the safety instrumentation wasn't working, the shift hand-overs processes were ignored, for example. Would they have done anything about it if you walked in the control room and there was a big sign saying that? Surely, somebody would have said I'm not sure is quite right. And that is a concept that we use to the staff.

And, basically, we create these so-called charts, which is the Swiss Cheese. As I said, the outer ring is the thickness of the barriers and we have four levels of measurement. Blue is best practice, green is target, amber is tolerance and red is obviously the KPI is not performing. We have full drill-down capability. The other point was it's no good producing spreadsheets, going and talking to staff, what's the problem, and then having to spend hours finding where the data came from. We wanted this to be a tool that the workforce could use to solve the problem every day. So, therefore, there's full drill-down which gives you exactly why that indicator is red and you can drill right down to a piece of work that hasn't been done or even down to a person who hasn't filled a work order card correctly in terms of, for example, how many hours are recorded on that or which person didn't do the shift handover correctly. That's a visibility in the organization and that drives a culture change. And one of the diagrams there shows a dramatic change over 18 months. It's preventative maintenance, corrective maintenance. One plant was completely turned around just by (INAUDIBLE). Normally, in fact, we cut costs. The other thing this program has done, we've taken over 20 percent costs out of the business, the reliability of the plant has gone up and forced outage rate has gone down by 50 percent. Process safety using this approach improves business

performance. And to answer the questions that came before, our industry is under extreme pressure in terms of costs. This stops you cutting costs by taking out the core basics that you have to do because if you do that, you will see immediately. But what it does do, it energizes the whole workforce to do exactly the right thing every day. And that means the business performance improves.

And, that's another shot and you can cut this across 24 plants, I can look at the whole company, I can look at one plant, I can look at one indicator and I can drill down as I say to one piece of work that hasn't been done. Finally, the key thing we find up in the measures but the key thing for us was to fold the new governance process in. Every day, the indicators are used, the system is updated every 24 hours automatically from a range of core systems. And the concept is if the line management deal with those indicators every day, you won't have an incident because they will get on top of what the issues are immediately. We then cascade up right to the board level every month and we use a live system every month at the board level. And all the information is recorded on the system so that actually the workforce can look at the monthly report, the board's report on what's happening and where things have been done about it. And that cascades right down to plant and team level. Each team has to produce a report, so it's quite easy to see that our maintenance team has not been doing the correct work and they have to answer for why that is and what they are going to do about it.

So, really, that concludes my journey. It's relatively quick today but hopefully you can see you have to make this visible and you have to make it relevant to the workforce, not just to the CEO because it is the workforce who you're protecting and it's the workforce who actually know what needs to be done and they will make it happen if you work with them. So, thank you very much.

17 Questions & Answers by CSB Board, Staff and Public

17.1.1 RAFAEL MOURE-ERASO

Thank you, Mr. Sedgwick. I guess we are going to proceed with the questions from the board. I will start with Mister-

17.1.2 MARK GRIFFON

Shaking it up a little.

17.1.3 RAFAEL MOURE-ERASO

Yes. With Mr. Mark Griffon, please.

17.1.4 MARK GRIFFON

I always like to follow John's questions but okay. Let me start with I have a few questions for Mr. Lubinski because I am quite intrigued on the NRC's experience with regard to indicators. And, looking at your – the website and some of the reports, I was curious. There's some categories – you held up the one printout and I was looking at that site and it struck me when I first glanced at the one online that every site under every category is green, so I'm wondering if how sensitive are these indicators that you're looking at. If everything is green, which indicates basically lower level or good, I guess. You know, how sensitive are these and are they able to-

17.1.5 JOHN LUBINSKI

Yeah, with respect to – not every one is green but I get your point. It's you know it is almost all of them are green.

17.1.6 MARK GRIFFON

I glanced so quickly but yeah.

17.1.7 JOHN LUBINSKI

A quick shot, and that's what we're trying to show there is that you can have a quick look and see how things are going at the plants. One of the things we're very comfortable with respect to those indicators are that these are really a lower level of what the regulatory requirements are. If you look at the occupational radiation hazards as well as the public, it's well below what our regulatory requirements are. So, in looking at and try to drive it even lower, that's not our mission; our mission is to maintain safety. And they're already multiple below what our performance standards are, we look at that and say that they're doing a good job and that the indicators are still performing well. We do have people bump up against those performance indicators and when they do that, they'll jump into the white range and then we do an evaluation. Now, with that said, we don't just stand on our laurels at that point. We do a self-assessment every year of our oversight process which includes our inspection as well as our performance indicators to determine whether or not, one, we need to lower the performance indicators to have that range and then also whether we need new performance indicators based on what we're seeing in the industry. And, at this point, we have not identified any changes being needed.

17.1.8 MARK GRIFFON

Okay. Yeah, that was a follow-up question I have was do you ever re-examine the level of the indicator and lower it or you do look at that as continual improvement.

17.1.9 JOHN LUBINSKI

Right, we do look at that- And as part of our self-assessment, we do surveys every year. Every other year, we do an internal survey and then the odd year, we do an external survey asking external stakeholders for input whether or not they believe the program needs to be changed as well. That's published in our Federal Register and we publish the response we have to the questions as well.

17.1.10 MARK GRIFFON

And then just to follow-up on this. Under the – I'm looking at a report – and you can tell me if I'm comparing apples and oranges – but under the it's a base, I think it's looking at baseline frequencies in 1988 to 2010. And under the initiating event category, there is something that you define as – you have two – BWR, boiling water reactor, general transience, and then PWR, general transience. And I note that the frequency of events for that category is quite high compared to the other metrics.

17.1.11 MARK GRIFFON

So the question I have is it seems like general transience that covers probably a broad-

17.1.12 JOHN LUBINSKI

It covers a very broad – I don't know exactly what report you're look at, I don't have it in front of me.

17.1.13 MARK GRIFFON

Sorry, yeah.

17.1.14 JOHN LUBINSKI

No, not a problem. But we do look at – one is our performance indicators are site-specific and we look at the sites themselves. We also look at general trending across the industry and we would see from a transient standpoint based on external initiating events. And we trend that to determine whether or not our program needs to change. I didn't talk in detail about that in our self-assessment. But we will look across the industry as a whole to say our we focusing our efforts in the right area. We just had a meeting with our commission on June 1st reporting out on a paper we sent to the commission that there was an increase in initiating external events, which would cause transience. We noted most of those in those in the last year had been a result of natural phenomena, whether it was flooding, tornados or earthquakes that occurred. We had an earthquake in the Virginia area, which impacted a plant, we had several tornados come through which impacted several sites.

So, there were losses of off-site power. And we're looking at that now to determine even though they were not within the control of the licensees, did the plant respond appropriately, did the safety systems

respond appropriately to those transients that occurred. And our belief is that our system is working because the plants responded appropriately. There was an issue in one case that we have taken care of but we are continuing to monitor that to see if there were to be an increase in these external events, would we need to look at our performance indicators and would we need to look at our program to make changes. I guess the other way I was looking at was under that category, do you get more refined data at the agency that may not be incorporated into your publicly disclosed so that you have more sort of the – to use his word is drill-down capacity.

We do drill down. And to make a note here is that the performance indicator program comes on a quarterly basis. We get this real time, though, when it occurs. Licensees are required to report it. We have resident inspectors that we follow up. So, on a plant-specific basis, we get this information and we react and we require the licensees to react to that information when it occurs. And the more important part of that is making sure that, one, they take appropriate corrective action; but, two, they look at the lessons learned in the extent of condition across the entire plant to make sure that they are handling other systems that may have the same common cause failures. And then as a side, we look at it from an operating experience to determine whether we need to get information out to other plants to let them know that this would occur. And that information is all made available to the public. I wouldn't say real time from the standpoint of immediately get it but within days, maybe weeks after we get the information, we do put it up on our website.

17.1.15 MARK GRIFFON

And the – I was fascinated, I think many in the audience might have been, too – of your description of the fact that this program is voluntary and yet what you said after that didn't make it seem very voluntary for most of the reactor community. But I think it's the nature of your business, right.

17.1.16 JOHN LUBINSKI

And when I commented voluntary, the program was put in place about 12 years ago and it was actually the industry that wanted a more transparent oversight program. You know, they felt it was too much the NRC looking at inspection findings, kind of having closed-door decisions on how to spend our inspection resources. And what we said is from a voluntary standpoint if the plants do not want to participate in that program, they can send us a letter and pull out of the program. And that's not looked at as a negative, but they would be put back under our old regulatory scheme, which they believed was more subjective rather than objective. My comments today about the voluntary nature is it's still voluntary but if we believe there are concerns, we can take appropriate regulatory actions.

17.1.17 MARK GRIFFON

And the last question for you and then I think I'll share some time because I have other questions for the other panelists. But you mentioned in the development – to get to sort of our side of things here – the development of this, I was particularly interested that NEI was- assisted you in identifying the metrics. Did INPO have a role in any of this or do they have a role in any of the performance indicator side of the shop for-

17.1.18 JOHN LUBINSKI

INPO was invited previously. When I mentioned NEI, NEI was one of the leading industry groups. It was open to the entire industry. INPO did participate in providing input. When we went through the process, NEI on it's own initiative decided to put together their document which they believed best described their performance indicators. Rather than doing a duplicative effort on our part at the NRC, we had others come in on that document as well and decided to endorse that document, rather than being duplicative and come up with a separate document. So, INPO was involved in the development. And when I say implementation, NEI is not one of the main implementers. It's NRC's program, we implement the program but we rely on their document as far as information.

17.1.19 MARK GRIFFON

Very good. I'll turn the mic back. I do have questions for the other panelists but I'd like to share the-

17.1.20 RAFAEL MOURE-ERASO

John.

17.1.21 JOHN BRESLAND

Okay. Thank you, Mr. Chairman. I'd like to thank the panelists for four very interesting presentations. I think we're being a little unfair to you in asking you to condense all of your knowledge into 15 minutes because there's a lot of really good information from each of you. But, it seems to me in a general sense just looking at, just listening to the four of you that there's a general agreement that KPIs are a good thing and they work well. But each of you comes up with a different way of doing it, which is fine as well. You have to – we're not going to change your minds today about going back and starting all over again. But in a general sense, what – I mean this is a question to each of you and you may or may not want to answer it – what do you think is the best way to do this. You're all doing it in a different way. Are you all pretty happy with the way it's working. And I know Ian isn't actually – well, you're regulating it but it seems like you're saying to companies you go out and do it and figure out what the best way to do it. The Defense Nuclear Safety Board has an interesting concept of comparing production and safety, which is something that we hadn't heard before. But what do you think is – I mean what works best here do you think or are you all pretty happy with the way it's being handled?

17.1.22 IAN TRAVERS

I'll start. John, as I said, we're not prescriptive on the way people manage risk. We're prescriptive on the outcome but not on the means. So, for us, major hazard companies have to determine how they control their risks, so therefore they have to determine for themselves how they measure and monitor the effectiveness of those systems and the assurance for us comes from the robustness of the process as they're put in place. And we don't, you know we don't turn away people who say actually I've got a very rigid way or I copied x, y, and z and I use that system. As long as it works and as long as it's focused on the controls of containment, we would be fairly satisfied. So we find enormous benefit of having a process rather than an answer in terms of how people work out what kind of KPIs they need.

17.1.23 JESSIE ROBERSON

I guess one way to respond to your question, you do have a nice assortment. You have a couple of regulators, you have an operator and you have an overseer of a regulator. My agency is not a regulator. We conduct external oversight. We don't write the regulations; rather, we ensure that DOE and its contractors are implementing the requirements that DOE has established. And, in that regard, my agency collects information, usually information that the operators are already producing, primarily data that they're already producing. We collect that information in a variety of forms and then we put into the context of the operation being reviewed and we draw conclusions and those conclusions are also aligned with whether the regulator and the operator have seen the same vulnerabilities and if they are correcting. And, so, we make our decisions as to what action is necessary based on whether we're the only ones that see the problem or the operator has identified and has already taken action to address it.

17.1.24 JOHN BRESLAND

I remember one person from one of the organizations that you oversee saying to me that one of his – I'm not sure if it was a key performance indicator but it was something – he said, "What we want to avoid is an unintended nuclear detonation." And that seemed like a good idea.

17.1.25 JESSIE ROBERSON

That's a good thing. That's a good thing. And we do. We focus on the health of the foundational systems, conduct of ops, maintenance, emergency response. And so I think each level when it comes to performance indicators, it depends on where you are in that hierarchy, what specific indicators you should be looking at.

17.1.26 JOHN BRESLAND

Thank you.

17.1.27 JOHN LUBINSKI

And answering your question. I'm very comfortable with where we are with our performance indicators. Also during my presentation this afternoon, I spent a lot of time on our oversight process and findings. In my opinion, that's the more important aspect because through inspection findings, we can identify whether or not there's any weaknesses in the plant and we can use key performance indicators in that area to determine from a normalized standpoint across the industry – is our regulatory response appropriate and is the licensee's response appropriate in moving forward. John, from our experience, a number of things involving the workforce, particularly the workforce who are actually at risk and the ones who actually do the work every day. Secondly, automating the data so it's used daily as the core business tool, not something that is a report on senior managers' desks that mean nothing to the workforce who are actually living and breathing the incidents or doing the work-arounds because once the whole workforce is energized in the same way and knowing what the indicators are, that will drive the change and prevent the accident.

17.1.28 JOHN BRESLAND

Okay, thank you.

17.1.29 RAFAEL MOURE-ERASO

I always wanted to say this. I yield my time to the gentleman of Denver and ladies and gentlemen. So, CSB staff go ahead.

17.1.30 BILL HOYLE

Thank you for your yield. I have a question for Mr. Lubinski at the Nuclear Regulatory Commission. It was very interesting to hear you talk about unplanned outages or unplanned shutdowns as an important thing to be tracking and to be worried about. And I think it's important to think about that in terms of API 754; what's that connection there or is there one. The US government's Energy Information Agency published a report in which they studied a six-year period in the US oil refining industry within the last decade. And the report found that there were more than 1,100 unplanned outages, unplanned shutdowns in US oil refineries. It strikes me that that's a lot. I could be wrong. And but do you think that would be that these unplanned outages, unplanned shutdowns in refineries would be a valuable metric for API 754?

17.1.31 JOHN LUBINSKI

I can't comment from the standpoint of 754. But commenting from our importance to that is we've looked at it and said you're challenging safety functions at the plant and we look at it from the standpoint of some of these are internal where it was a mistake on the part of an employee or an equipment failure that occurred. So that's another indicator there that the cause of what the shutdown was to occur means there was another performance deficiency occurring along the way. In most and if not all of these cases when these shutdowns occurs, there's not an impact on safety, there is a safe shutdown of the plant and the plant responds accordingly. But it tells us whether or not there's something else going on at the plant if they continue to have these shutdowns based on performance issues, based on equipment malfunctions, based on procedures at the plant being inadequate, that tells us that there may be a safety issue and that would give us, as I said earlier, a lagging indicator of a precursor type event occurring.

17.1.32 BILL HOYLE

Yes, just to follow-up. Often the unplanned shutdowns are handled safety and there would be a celebration about the success of the shutdown. But isn't that a celebration of a failure?

17.1.33 JOHN LUBINSKI

And when you say celebration – we don't look at it as a celebration, we look at it as that's what's expected. The systems are in place that it would be shutdown when it were to occur. We still look at it from the standpoint of being negative if you end up having multiple of these occur.

17.1.34 BILL HOYLE

Right. Thank you. I have one more question for Ms. Roberson from Defense Nuclear Board. The board has done a great deal of work recently, exemplary work on safety culture and elevating the importance of that in major hazard operations. What are your thoughts and what are the board's thoughts about safety culture in terms of safety indicators and metrics? Have you begun work on that and what are your thoughts?

17.1.35 JESSIE ROBERSON

Thank you for the question. The board has done a lot of work on safety culture and I would say another phrase to describe safety culture is an organization's decision-making and value system. And, so, we've done a lot of work on safety culture as a way to wrap-up connected issues like lack of follow-through on corrective actions, using untested technologies, failure to resolve technical issues. And, so, safety culture to some seems like a soft issue. But, for us, it is a way to describe an organization's decision-making culture that is very technical in nature.

17.1.36 BILL HOYLE

Do you think it would be valuable for the oil industry to seek to have indicators of safety culture performance?

17.1.37 JESSIE ROBERSON

I think it's good for any organization. In fact, our own organization has such for the way that we conduct our business. I think how an organization makes decisions is essential to any, it should be essential to any leader.

17.1.38 BILL HOYLE

Thank you.

17.1.39 KELLY WILSON

Mr. Sedgwick, my questions are primarily for you. First, I was wanting to ask you about how Iberdrola addressed contractors within its system and how it wrapped contractor work into the indicators that it collects.

17.1.40 MARTIN SEDGWICK

Thank you for the question, Kelly. Yes, actually we view contractors as our own staff. They're fully engaged in the process. Where we have areas of operations and maintenance contracted out, they have to use our processes and systems and they are linked to the KPIs. They also have a valuable contribution to make towards process safety with knowledge as well. And they can bring good ideas from other sites that the different companies work on. So we have no demarcation between contractors and our staff in this approach.

17.1.41 KELLY WILSON

My second question is more maybe in line following on the discussion of API 754 from earlier. In looking at the discussion about tier three and four indicators in API 754, it seems that at least within the body of discussion earlier today that it perhaps is difficult to standardize these across different kinds of assets so that they have valuable trends or can be benchmarked. But Iberdrola it appears has created indicators across a variety of assets. So, it seems like that's – would you say that the first true or how has Iberdrola worked through that.

17.1.42 MARTIN SEDGWICK

No, I would agree it's true. Basically, if you take any asset – and I try and look at it simply – has your asset got pumps, has it got valves, has it got pipe work, has it got a vessel with a level. Well, it could be any process. So, one of the issues I think with process safety indicators, we can get too tied-up with these discussions. It's actually better to do something and start measuring something. So, basically, we got together. We have a range of assets from heavily regulated nuclear sites through the (INAUDIBLE) process (INAUDIBLE). So, you know I've very familiar with those processes. In fact, I was a nuclear desk operator. So, you know you can bring different experiences in. But what we said was never mind the complexity, let's get together and agree tier three indicators that we can apply right across and let's start doing it. And that has driven dramatic performance improvements in terms of near misses learning. And, basically, we have a system, we every power plant in our fleet and we've got over 200 worldwide, we have what we call a technical recommendation process and when we have a tier three, two or one, but mostly tier threes, it's emailed around automatically to everybody in the world in our power plants immediately. And we've all got a common base. So it can be done and it's better to do something, make it happen.

17.1.43 CHERYL MACKENZIE

Frankly, my question, I'd love to hear answers from all of you. I'm not sure if we have the time, so I'll direct it to John at NRC. Because you mentioned on slide 12 that the indicator data that you were showing us are available to the public. And I was wondering what does NRC see as the value of public reporting and does it impact safety performance by the industry.

17.1.44 JOHN LUBINSKI

The short answer is yes for your second question. Yes, we believe it does as far as impacting the performance. Under the old system I didn't talk about much is that we had what we called a traditional enforcement system. When we had findings or we had people that were outside of a key performance indicator, we could take enforcement action issuing citations, issuing monetary civil penalties. What we found is this is actually a more risk informed and also a benefit from the standpoint of moving forward to increasing performance. Number one is it focuses the licensee's effort and the NRC inspection efforts in the correct area. But, number two is because all of the information is made public, not just when a bad event occurs at a plant, all the information. It requires all the licensees to look at it and say how are we being publicized on the NRC website. The performance indicators are not a report card; however, they are information. And we think that information being available, not only does it have the licensees more accountable for safety but it also has us as the regulator more accountable. When the public is looking at this website and saying how can you have a plant that has white performance indicators, yellow findings and you're still letting them operate, what is your technical basis for doing that. So it holds us accountable in being able to describe what the safety performance is of that plant. So, that's where we see the benefits to making all this information available to the public. The final one is just the fact that from our standpoint we believe in open and transparent regulation and we want the people in the community to understand what the hazards are associated with the plant and what the safety implications are of any activities that are occurring.

17.1.45 CHERYL

Thank you very much.

17.1.46 DONALD HOLMSTROM

My question is for Mr. Travers. Mr. Travers, I've read a recent document related to the future going forward of the (COMA) program and discussing indicators and it seemed to be saying and I'm just trying, I want to get your reflections or for you to elaborate on this that indicators aren't just a good idea, if you don't have them, you should probably do them. It seemed to be saying that indicators are going to be sort of a central focus for COMA and HSE regulatory activity in the coming years. And maybe you could describe that. Or maybe I don't have that right and you can correct me.

17.1.47 IAN TRAVERS

Sure. To us in terms of looking at organizations, and we see our role as standing between industry and society and giving industry the kind of license to operate. So, we know all the awkward questions to ask and as long as we have the trust of the public that we represent, they are quite happy for us to ask the questions and don't ask them directly. So, KPIs are in that kind of a scenario, KPIs are evidence. If we turn up to a site and we're looking at asset integrity and how you manage containment and companies say, well, we've got this system and here's our arrangements and our procedures and our staff are trained; well, show me the evidence it works. Where's your information to say that you're doing it, where's your information to say that you're finding out where it's not actually working so well and you're acting upon it. So, for us in a regulatory dialogue with an individual duty holder, KPIs are evidence; and, so, therefore, when we're looking at the future of controlling major accident regulations in the UK, it's part of that dialogue. So if you can't provide us with information about how you're controlling risk and that evidence is not robust or it's assertion rather than data, then we don't believe it. So it makes compliance a much tougher job.

17.1.48 RAFAEL MOURE-ERASO

I would like ask Dr. Horowitz if we can start picking up questions from the public and then if necessary to come back to this later.

17.1.49 DANIEL HOROWITZ

Okay, great. The first question from the audience is to Ian Travers and it is from Tim Overton who actually had to step out for the day. But the question reads: The HSE approach to metrics appears to not use a standard set of metric definitions but instead to ask each facility to develop metrics which are based upon the specific process. And the question – the questions are: Does this approach result in a lot of variability between companies regarding the robustness of these metrics and does it end up with hundreds or thousands of metrics per facility.

17.1.50 IAN TRAVERS

Okay, I'll start with the second one first. One of the early warning signs when we would get concerned about an organization if it had hundreds and thousands of performance metrics. We started when we started on this path saying six is good enough for us. So, if you've got six good key performance indicators against your major hazard risks, as long as they're focused on the critical things that go wrong, that was a good starting point. And it wasn't that we thought there should be six but we definitely didn't think there would be 600. So, if we came in low with the number, we will constrain; and, dare I say with due deference to Martin, engineers' enthusiasm for measuring things. So, we definitely wanted to ask people to focus on a very small number or just enough, but that was a small number, not a large number. Does- do you get a large degree of variation? The answer is yes to at first when you first look at them, you

do because we have a very large variation in the industries we regulate from fuel storage sites to refineries to chemical processing to offshore installations and chemical warehouses and pipelines. So, of course you're going to get a variation. But, actually, when you step back from the variation, you actually see that there's a great deal of commonality because the way things fail are common and the way things – the way people control risks are common. So, generally in our industry, onshore, the way things fail is through corrosion and failure to manage the asset, over-pressurizing the process, through human error, physical damage and things like that. And the ways that people control those risks are common. So, surprise, surprise, the suite of indicators tends to look like – well, it shouldn't be a surprise – things like the CCPS list of process safety management attributes. So, actually, the commonality comes from the fact that in the chemical industry, you can't see what's in the vessel, so you need some instruments and alarms to tell you the conditions, you need people who are competent to do critical tasks, you've got attacks on the process through things like corrosion and physical wear. And so that's where you get your commonality. And as long as people are measuring in those areas and using the data to look critically at how they're managing that risk, I don't worry about the variation.

17.1.51 DAN HOROWITZ

Thank you, very interesting. And the next question is for Mr. Lubinski and it reads: You said reporting information tied to leading metrics is voluntary, yet if a company does not report the information, enforcement actions can be taken by the Nuclear Regulatory Commission. That seems to be a contradiction. Can you explain more why the reporting is considered voluntary.

17.1.52 JOHN LUBINSKI

Sure. I'll expand a little bit more on that question from the board from Mr. Griffon. Is if a licensee continues to say they want to be part of this voluntary program, they need to live up to that commitment, and that means providing this information to us and that means that information must be complete and accurate and we would verify that they're providing that information. If they fail to report that information and we feel it's needed, we can go look at that as long as the licensee is still saying they want to be part of this voluntary program. If a licensee would like to pull of this voluntary program, if a licensee would like to pull out of this voluntary program and go into what was our old oversight process, a licensee can choose to do that. So, that's what we mean by the voluntary nature of it. But, once they commit to it as part of the program, it's not a regulatory requirement to do it, it's not a regulatory requirement to be under this program. It's their choice to be under this program; but they must live by that commitment. And that's why we had the strong language when I was discussing that slide is once you commit to the program, you must be fully committed. And, we will, if you provide us incomplete or inaccurate information, we will take enforcement action because at that point, you are not living up to your commitment because you're providing us false information. And we need that to have validity to the program.

17.1.53 DANIEL HOROWITZ

Thank you. And the next question is from Belinda Theland of the United Food and Commercial Workers and it is to Mr. Sedgwick. And it reads: Did you find a need to increase maintenance staffing levels in order to address the problems flagged by the key performance indicator program?

17.1.54 IAN TRAVERS

Actually, no. What we did find through the key performance program was works planning could be improved, the way we put people to work, making sure they have the tools and equipment. When we

started measures in that area, we found that our workforce was the actual span of time was 20 to 30 percent. And, again, working with the workforce, what we were able to do was improve the productivity and actually start to reduce contractors, which in essence protected the workforce and started to drive down costs, which again protects the workforce. So, by engaging as I say across sections and staff, including the unions to make that asset more efficient and to improve process safety, you protect everybody's livelihood, work, and the asset becomes safer as well. So, we didn't – we actually reduced costs by about 20 percent across the fleet.

17.1.55 DANIEL HOROWITZ

Thank you. And the next question is for Mr. Lubinski. And it reads: You mentioned that the NRC focuses on indicators that are indicative rather than predictive. Do you mean indicative in terms of more lagging indicators like the number of unplanned shutdowns? Why not focus on indicators that are more predictive?

17.1.56 JOHN LUBINSKI

We think it would be great to focus on more predictive indicators. The difficulty is identifying those. We don't look at our indicator- we don't see that we can come up with an indicator that is truly predictive that you're going to have an accident, you're going to have an occurrence. Instead, we look at it and we said it's indicative from the standpoint that past performance, current performance is indicative of what the future performance is going to be. And we look at it from the standpoint of precursor events associated with those key performance measures. So, we considered a lagging indicator on the precursors of an event, which we believe in some ways can be predictive but we're not trying to sell that as predictive because again you could have someone who is managing correctly to that but the – what we refer to sometimes as the "cliff edge effect"- that you have this very low probability event that it could just occur. And we've had that in the past with certain plants where they have had been in column one of our response, have had good performance; and, then something happens at the plant and, if you will, they just go from column one all the way to column four with an event occurring. So, we would love to have a predictive indicator; the problem is we've just not been able to identify any predictive indicators at this point.

17.1.57 DANIEL HOROWITZ

Thank you. And I believe that's it. Does anyone have a question on a card? And would anyone like to comment or offer a question from the floor? Go ahead.

17.1.58 JAKE MOLLOY

Jake Molloy, M-O-L-L-O-Y, from the RMT Offshore Workers Union. And I worked in Scotland. The second session this afternoon has been very enlightening compared with the previous session on the basis that one of the speakers, Mr. Keim, said that the system they had in place through API was unambiguous. I'm not academic, I'm not an engineer, and I'm an offshore worker of 30 years. And I find it nothing but ambiguous. Sorry if that's upsetting but that's from an offshore worker's perspective. How you are able to have any input into that system is frankly beyond me. But that's the question. You're the experts, the panelists. Can you offer – I'm putting you on the spot here – can you offer your opinion as to whether or not the system currently in use here is ambiguous or not?

17.1.59 JOHN LUBINSKI

As I stated earlier when the question of how our system compares to 754, I have not reviewed that and cannot comment on whether or not it's apples and oranges and how applicable it would be.

17.1.60 IAN TRAVERS

I'm not sure about whether it's ambiguous or not. I mean I started this work when there was nothing and so anything rather than nothing is a good start and that's not to put API down in any way. I have a bottle of Champagne and it's sat for ten years and goes to the first site that I walk onto that has a board outside, or, indeed, the first company that reports in its annual report its process safety incident rate outside the plant. And, so, the value of API to me is that it started a very, very important discussion and it set down a set of parameters that are – nobody could describe as perfect but it's an important step in the right direction, particularly where the industry is prone to look to its competitors of what they're doing. We heard this morning about Solomon Index and all of that. So, anything that points to the performance in a very critical area as a very important first step is to be welcomed. Okay and so it isn't – it isn't the complete answer and it isn't an absolute way to do it. But I don't see there's any other agreement globally on what a process safety incident is. And (INAUDIBLE) oil industry and across Europe to (INAUDIBLE) to adopt the same standard. Not because I think it's perfect but it's a start and it's a start to start to understand and unpack performance. Our industry have used it in the UK and they've found very little data. But what they've done with the data is they've drilled down to those incidents and those events and they've asked what was the underlying cause of that incident. And they've come up with – as happened in the UK offshore industry – some very clear and obvious things that are common that underlie those loss of containments or those process safety events. So I think it's a good start but it's not where we need to get to. There's a very long journey to do that. And I guess for me, there are a couple of people who need to get engaged in this. It's the people who put up the money to invest in plants and equipment without the information to know how well their investments are being used. And, so, I would really like to get engagement from the insurance and the investment sector into this process because I think they have a valuable role. But, I like simple analogies. And ten years ago, people were driving their cars, getting a new car out of the garage, disconnect the speedo, the oil warning lights, the fuel gauge. And because it's been made by a reputable dealer, I'll just drive it and it's going to be fine; whereas, now, there's more visibility on the condition of the things that are important. And this is a journey. It's not the end of it. It's definitely bringing more visibility, more understanding about the condition of the plants and equipment that we rely on.

17.1.61 MARTIN SEDGWICK

Sorry, I – say from again practically trying to implement rather than shall we say the theoretical paper because one of the dangers in all the regulations and documentation is how do you measure it, who reports it, how do you gather that data. So, on one hand, you can define concepts and ideas, but somebody has to practically deliver it. And, to me, that is the link that's often missed in that what is it you're trying to measure, why are you trying to measure it, how do you measure it, how do you engage the workforce is one aspect. But API gave us good guidance and general ideas, but I will come back that – and it's human nature when we have an incident and a near miss, we, everyone gets thrown at it to come up with lessons learned. And, you know we pat everyone on the back for the lessons learned but unless we get a grip of the leading indicators and stop incidents occurring, we won't- we won't get to a position where people aren't injured or, worse case, killed if we rely on lagging indicators. We've got to stop things going wrong and the best thing to do is to have leading indicators and what we do in our company now if is our operations director, we have an on-call, an award system that sends out congratulation emails to

different plants or different people whose leading indicators are in a good order, whereas before we'd send out well, you know, that plant tripped off, great that you got it back on time or you got it back. We now have stopped that and we go for the proactive. So, that's my view.

17.1.62 DANIEL HOROWITZ

That leads actually to another question we got over the email to Mr. Sedgwick, which is: What is the core reason for the success of the Scottish Power indicator's program, is it early management support. The question you were asked, I think you've answered it in part but is there anything you'd like to add?

17.1.63 MARTIN SEDGWICK

Yeah. Firstly, we didn't in terms of process safety, there's a danger that organizations believe that process safety is all about the indicators. Obviously, the two days we're here is about indicators. So, they go and start developing the indicators without taking either the leadership or the workforce with them. So, we started off by engaging, as I've said on a number of occasions, with the CEO right down to the workforce. Why are we doing this, what will we do. So, you have to engage first and then actually the whole organization comes along with you, understands the indicators. The other success is making it visible to everyone, making it part of everybody's job every day. Whatever they do, they play a part. And people do feel valued if they're engaged and involved and they can see that and understand why is the shift handover and certain information important. They can see that the organization values that because it measures it.

17.1.64 DANIEL HOROWITZ

Thank you. Any other commenters from the audience, questions? Was there one? Would you like to come to the microphone, ma'am?

17.1.65 MARTIN SEDGWICK

The question is how do we train the staff, in particular the CEO. It's a good question, yeah. Well, there are various training courses that have been developed over the years. But we developed our own leadership program and that leadership program went from the CEO down to the shift supervisor or maintenance supervisor down. What we did was we developed this program and we mixed everyone up, including the CEO, and we had a written test. And, so, the CEO trained alongside shift supervisors, maintenance supervisors, and engineers. And it was an interesting point because our company board said, first of all said, "No, we'd like the training on our own." But actually I stopped that because I said, "No, you need to engage with the workforce and do the same written test," where we had a pass mark. So the CEO had to do the test with everyone else. And that actually – that – we didn't have to put out a communication that that happened. I can assure you that drove the program. I won't tell you the test results. But it was okay.

17.1.66 DANIEL HOROWITZ

I think that's it. I want to thank all of you who have stayed here through the end of today's proceedings. Really a fascinating day from our perspective and I hope from your perspective as well. Throughout the day, we've been quietly experimenting with a webinar version of the hearing. And, tomorrow, we're ready to take it fully live. So if you have colleagues back in the office who cannot make it here and are interesting in watching on the Internet, look for an announcement on our website tonight and

we'll explain how to connect to that webinar tomorrow. I want to encourage everybody to join here again at 9 a.m. tomorrow for a really vital part of the program now that we've established the basic framework around process safety indicators. Our investigative team will present its findings on how process safety was measured, what indicators were in place prior to the Macondo blowout. And this is their first significant release of preliminary findings over the two-year course of the investigation. So it really will be a very important presentation tomorrow morning. Thank you, Mr. Chairman.

18 Closing Remarks for Day One - RAFAEL MOURE-ERASO

Yes and I wouldn't like to close this session without a special thanks to our panel members. Mr. Sedgwick, Mr. Lubinski and Mr. Travers and Dr. Roberson. And, also I would like to thank the panel before, especially I would like to thank, especially Mr. Keim. I think he had probably a very heavy load to carry in that panel and (INAUDIBLE). I really appreciate you helping us on this meeting. And I would like to reinforce what Dr. Horowitz said, that tomorrow is going to be an extraordinary day. You should come and look at the preliminary findings of our investigation of Macondo as well as two very good panel discussions in which we are going to have- discuss regulatory stakeholder and public interest groups views on indicators as well as work organizations and unions and their view of indicators. So, please come tomorrow at 9 o'clock and we'll see you all there tomorrow. Thank you very much. Good-bye.

19 DAY TWO - Tuesday, July 24, 2012 – Opening Remarks

19.1 RAFAEL MOURE-ERASO

Good morning everyone and welcome for this day number two of our hearings on the Chemical Safety Board. My name is Rafael Moure-Eraso, I am the Chairperson of the US Chemical Safety and Hazard Investigation Board and I would like to get started and call this meeting to order. I do not want to repeat too much of my preliminary comments of the first, but one thing that merits attention is for those who might not have been present yesterday is the administrative matters that I would like to mention. I mean, first is in this room we have the regular entrance and there is an emergency exit if need be. There are on the two sides of the room. That is the first safety statement of today. Second, I want to point out that- that to facilitate the- the presentations of the- the persons that are going to be talking to us today, we have an agenda. There is a one-page agenda that was in the front and there is a detailed agenda in that also. It is a separate document that has the photographs and short CVs of the speakers. So there are two agendas.

Today, we would like to also as we said yesterday, to make clear that this is a public meeting and that we are having time after the presentations for the Board and staff to make questions to the panelists and also the members of the public, the people that are here will have time to address questions. The way that we do the questions is you can either email the questions through your smart phones to question@CSB.gov and they will be received in a center place and then they will be ordered and asked for whoever sent the questions by Dr. Horowitz. Or you can write a little card. There are cards, 3×5 cards there to write your question. Or the third way is there is a microphone there, you could approach the microphone and ask a question at the time of questions and answers.

We have to modify a little bit the agenda today. Our investigations team report on the Macondo Deepwater investigation is going to take a little longer; so it is going to be from 9:05 to 10:05, so the schedule is going to be shifted accordingly. And, also there has been some changes from the composition of the panels and I will be telling that to you. At the time that the panel comes, I will introduce everybody. We would like to start as soon as possible with the report of the investigation team on the Macondo investigation of the CSB and the person addressing this meeting will be Mr. Donald Holmstrom, which is the investigator in charge of this investigation. So, Donald, please. Oh, yeah. I'm sorry. I forgot – before going to Don, my apologies to my fellow Board members. I would like to give them an opportunity if they want to have to say some statement before starting.

19.2 JOHN BRESLAND

Okay. Thank you Mr. Chairman. Your apologies are graciously accepted. Just a couple of comments. I've been on the Board for two terms, a total of ten years. I've been involved with I guess all of the accident investigations that have taken place on the Board. My- my two terms are coming to an end. My second term is coming to an end, so I'll, in the foreseeable future, I'll be dropping off the Board and moving on to something different in my life. But, I guess the- the two sort of- the two thoughts that occur to me when in thinking back over the last ten years that seem to strike me as ones that remain in my memory and I and I puzzle with. The first one is I know we've investigated BP Texas City and we're investigating Deepwater Horizon and it just it has always puzzled me as to why a major company like BP with the quote unlimited resources that it has is the company that was involved in the two worst accidents

that we have seen over the last ten years. And, hopefully, we can figure out why that was and what the answer to it is.

The other thought I had is I know BP Texas City was a tragic accident with many terrible fatalities, but I've often thought that had it not been for the fact that the trailer was not- if the trailer where the people died in had not been located at that spot, those people wouldn't have died and we would've- but I'm thinking that if that was the case, we probably wouldn't be involved or have been involved in the investigation of BP Texas City because it would be a – I hate to use this word – but it would have been a routine fire in the oil industry, the refining industry. And there are still too many of those that we see and we need to figure out through meetings like this, through investigations like this, what can we do to prevent those again. Too many accidents like this that sometimes we investigate and sometimes we don't. So we need to – we really need to work hard and the industry needs to work hard on preventing these day in, day out so we never do have something like Texas City. So I'll turn it over to Mr. Griffon.

19.3 MARK GRIFFON

Thank you. Yeah, just a quick opening statement. I mean I look forward to our transition today to some discussions on the offshore process safety issues. As everyone here knows pretty well, the Macondo incident has been widely studied, written about, covered by the media and talked about extensively. I think, one thing that I've noted as I've looked through a lot of the materials is that especially in some of the books and the media coverage, it's labeled as an environmental catastrophe. And I think most of us, of course, focus quite strongly on the fact that it was a tragic incident that involved the loss of 11 lives and serious injuries to 17 others; so, in that vein, many want to label it as a process safety incident. And I think that, you know, an incident like this, to me, really points out the interconnectedness of worker safety and process safety and environmental issues. And I think this came up yesterday with a few of the panelists that you can't sort of put blinders on and work in one area without thinking about the overall health of the process, of the organization. So, you know, I urge that we try to avoid these labels because I fear that once we label or pigeonhole something, the thinking, the solutions, the recommendations all tend to focus on that certain label.

And, so, I was encouraged by our conversation yesterday and I'm sure we will extend that today with our great panelists of you know how to think more broadly about incidents like this. And it's clear to me that the Macondo incident is going to offer many lessons learned for the offshore industry; but it's also very clear to me that this incident will offer lessons learned to many other sectors. And that's why I am very encouraged by our two-day forum here because I think it's allowed some of that discussion between various sectors and I think that learning is critical. So my message is that we avoid labels and we remember that this is not just a process safety incident or an environmental catastrophe; but, rather, it's all wrapped up in one and there's lessons across the board. Thank you.

19.4 RAFAEL MOURE-ERASO

Thank you, Mark. I would like to correct something that I said before in the way that the presentation is going to be made. We are going to start with Cheryl MacKenzie is going to make the presentation on the results of the preliminary results of the investigation. Cheryl is the Investigation Team Leader for this investigation and Don Holmstrom is the Director of our Western Office. So I wanted to make that clear. So, please, Cheryl.

20 Offshore Safety Performance Indicators – Preliminary Findings on the Macondo Incident - CHERYL MACKENZIE

Thank you, Chairman Moure-Eraso. Today the CSB staff is presenting preliminary findings of its Macondo investigation dealing with how safety was measured and managed offshore. In yesterday's hearing, we heard about the importance of using leading and lagging process safety indicators. One could say that operating facilities that have the potential for catastrophic incidents without use of such indicators is like driving cross-country without a speedometer; you don't know about the risks that you are taking. Use of robust indicators of safety performance is critical for onshore operations, and in offshore energy operations, they are every bit as essential. Onshore, the term process safety management refers to the use of safety systems to control hazardous processes that could have catastrophic consequences. There has been a OSHA process safety management regulation for 20 years. The offshore safety regulator did not require the use of process safety management systems until recently and so the use of the term "process safety" might be a relatively new one for many companies working in the Gulf of Mexico. In today's presentation, we will be using terms such as process safety and major hazard safety interchangeably.

We discussed this same table yesterday but it bears repeating. Millions of US workplaces primarily measure their safety performance using OSHA reportable, reportable injury and illness rates. Typical injuries in this data are dropped objects and slips, trips and falls. Injury, typical injuries -excuse me. Collecting such data is necessary in operations that have catastrophic hazards but is not nearly sufficient. Injury rates do not depict the effectiveness of a high hazard facility's process safety management program. CSB has found in its investigative history that many of the sites that experience serious major incidents also had low injury rates. In some cases, these sites had award-winning low injury rates.

In every case, CSB found major deficiencies in their process safety management systems. This is not a new issue. Process safety experts have noted that the Phillips Chemical Plant that was the site of a 1989 incident where 23 workers were killed had operated for several million hours without a lost time incident. The CSB Texas City incident report noted that BP's personal injury metrics were described as quote the best year ever; yet there had been three major process safety incidents in that same period, including the March 2005 disaster, that resulted in 15 fatalities. Personal safety does not equate to process safety. The table in this slide demonstrates some of the fundamental differences between the management of personal injuries versus the management of process safety.

When it comes to the effective prevention of explosions, fires, and hazardous chemical releases, special emphasis must be placed on process safety at all levels within the organization. We will discuss today how this crucial lesson as it relates to Macondo. In summary, what we found was that BP and Transocean had multiple safety management system deficiencies that contributed to the Macondo incident. Pre-incident, the safety approaches used by the companies and US trade associations did not adequately focus on major accident hazards. Systems used for measuring safety effectiveness focused on personal safety and infrequent lagging events. The US offshore regulator can achieve greater impact with major accident prevention through the development of a leading and lagging process safety indicator program. Despite some significant progress with process safety indicator implementation in the downstream oil industry, in the offshore sector, BP, Transocean, industry associations and the regulator did not effectively learn critical lessons of Texas City and other major incidents.

A key lesson not implemented was that preventing major accidents requires a specific focus on process safety management over and above conventional personal safety. Recommendations addressing the need for standards on the implementation and use of key performance indicators were not extended to US offshore operations. Companies and trade associations operating in other regulatory regimes outside of the US have developed effective indicator programs recognizing the value of leading indicators and using those indicators to drive continuous improvement. In other regulatory regimes, trade associations and many of the same companies that operate in the US are partnering with the regulator in advancing these programs. Post-incident, companies and trade associations in the US are initiating efforts to advance the development of offshore major accident indicators.

The CSB is also examining a number of additional issues that it plans to analyze further in its full investigation report. These issues will not be the focus of today's discussion. The CSB is examining these issues as they have significant preventative impact, they address topics where the CSB has significant agency experience, and they probe areas of inquiry that other investigations have not fully addressed. The CSB has a lengthy history of investigating catastrophic chemical incidents and making recommendations to improve work practices, safety standards, and regulation. One of CSB's strengths is its experience with analysis of process safety management systems. We will discuss how such systems were severely deficient in this incident. The CSB has a significant organizational history and capability to examine issues such as human factors, safety metrics, inherent safety, corporate governance, and organizational effectiveness. Additionally, the CSB is the only fully independent federal safety agency that has investigated the Deepwater Horizon accident and the only independent investigative body with subpoena authority.

The CSB has the unique ability to follow-up, track and advocate its recommendations. Most everyone here is likely very familiar with the details of the Deepwater Horizon tragedy. It occurred back on April 20, 2010, at the Macondo well, part of the Mississippi Canyon Block Number 252 located on the outer continental shelf in the Gulf of Mexico off the coast of Louisiana. The Transocean Deepwater Horizon drilling rig was contracted to BP. The incident began as a hydrocarbon blowout followed by multiple explosions. As a result of the blowout and explosions, eleven people and seventeen were seriously injured. This incident also resulted in approximately five million barrels of crude oil being released into the Gulf of Mexico. The desire to both understand the root causes of this incident and to prevent similar incidents has driven the Chemical Safety Board's current investigation. I will briefly review some of the key events leading up to the April 20th incident as they relate to the findings and analysis we will be presenting today.

After the drilling of the Macondo well had been completed, the activities of the drilling crew shifted to the process of temporary abandonment. Temporary abandonment consists of securing the well and removing all equipment above the wellhead. Once this has been accomplished, the Deepwater Horizon drilling rig would be replaced with a production platform capable of producing hydrocarbons from the well. An early step in this abandonment process calls for the installation of a cement barrier at the bottom of the well to seal off hydrocarbons, the hydrocarbon-producing zone. However, in this case, pressure testing of the cement job was misinterpreted and the crew failed to realize that the producing zone was not sealed. A subsequent step in the abandonment procedure called for the heavy drilling mud in the well to be displaced with seawater. Once this was completed, the pressure at the bottom of the well dropped enough to allow hydrocarbons to flow into the well and tore the Deepwater Horizon rig. Subtle indications that the well was flowing were evident from the data sent to personnel onshore.

Those with access to the data, however, failed to detect the flowing well for a significant period of time. The force of the hydrocarbons accelerating up the well resulted in drilling mud gushing onto the rig floor. A blowout was occurring. At this point, the crew took immediate action to close the blowout preventer and seal the well in around the drill pipe. However, by this time, hydrocarbons were already past the (VOP) and filling up the mile high riser connected to the rig. In addition to closing the blowout preventer around the drill pipe, the crew also closed the diverter at the top of the riser, an action meant to deflect the blowout to a safer location than the rig floor. However, the flow from the diverter was left routed to the default location – the mud gas separator – which was not designed to handle a flow of the magnitude of the Macondo blowout. Mud and hydrocarbons rained down on to the rig floor as the mud gas separator first vented high above the deck and then mechanically came apart.

There were alternate pipes, which could have been used to divert the blowout over the side of the Deepwater Horizon rig, but the hydraulically operated valves for this line-up required manual activation, which was not done. The hydrocarbons eventually found an ignition source and explosions and fire ensued. At some point after the explosion, flow of hydrocarbons throughout the blowout preventer was reestablished (the reasons are still unknown and under investigation). Automatic systems meant to sever the drill pipe and seal the well failed to do so. Subsequent attempts to activate back-up systems also failed to stop the blowout. Flow from the well continued until July 15, 2010, by which time the oil from the well constituted the largest offshore spill in US history. But, more importantly, eleven rig workers on the Deepwater Horizon lost their lives that day. I am now going to turn the presentation over to Miss Wilson.

21 Offshore Safety Performance Indicators – Preliminary Findings on the Macondo Incident – KELLY WILSON

Thank you, Miss MacKenzie. Safety management systems have been described as systematic, clear, and comprehensive processes for managing safety risks. It should not be surprising that deficiencies existed in the safety management systems aboard the Deepwater Horizon. And, as a result, risks were not properly managed by Transocean or BP. In this section, we will describe how effective safety management systems are developed. We will provide several examples of deficiencies aboard the Deepwater Horizon. We will offer possibilities into how indicators could be used to monitor the performance of these critical systems. These examples were not chosen because they are deemed the most important critical process safety failures. They were chosen because they are deficiencies that have been factually well developed in other reports and are likely to be most familiar to the audience.

The CSB, in our final investigation report, plans to address these and other deficiencies including issues around well control, the apparently delayed response to indications of a kick, and decision-making around the cementing operations. Effective safety management systems can be developed based on a variety of inputs, including regulatory requirements, industry standards and guidelines, and effective approaches developed from other industrial sectors and regulatory regimes. Major accident investigation reports from around the world can also contain valuable lessons to strengthen safety management systems. The regulatory approach is required to meet legal obligations. For example, where US OSHA regulations apply, the PSM standard applies to cover processes, facilities like chemical plants, and refineries.

In the US Gulf of Mexico, the Bureau of Safety and Environmental Enforcement, BSEE SEMS regulations require some similar elements. They both require an array of elements such as hazard evaluations, management of change processes, proper documentation in procedures and incident investigations. It is indicated here with a dotted line that while OSHA PSM has influenced the development of SEMS, it does not currently play a role offshore. In addition to regulatory requirements, safety management systems can be based on various sources of good practice guidelines. These guidelines can address technical practices, reflect lessons generated by accident investigation reports and audits and regulations in use in other geographical areas. The guidelines can cover issues such as safety culture, inherently safer technology, management of organizational change, and human factors.

One example would be papers published by the Society of Petroleum Engineers or the series of process safety guideline books published by the Center for Chemical Process Safety, an industry-sponsored association affiliated with the American Institute of Chemical Engineers. Industry trade associations and standard setting bodies can also provide guidance for developing safety management systems through standards, guidelines, and recommended practices. The CSB has identified a number of deficiencies in safety management systems that were utilized by BP and Transocean at the time of the Deepwater Horizon incident. Today we will highlight four examples of the deficiencies we found. These include deficiencies in hazard assessment, procedures, management of change, and incident investigation. They are illustrated here by the Swiss Cheese model. These four deficiencies represent failed layers of protection that could have presented- could have prevented the incident from occurring.

The CSB found that BP and Transocean hazard assessment management systems were inadequate. Our first example is the inadequate bridging document between BP and Transocean. A bridging document

integrates safety management systems between partners to assure project-specific risks are mitigated. However, the bridging document between BP and Transocean was a minimal document that focused only on six personal safety issues such as minimum heights for employing fall- employee fall protection equipment. None of the issues addressed- none of the issues addressed major accident prevention like well control. Moreover, the document was generic; it did not address well-specific issues and hazards. The development of process safety based bridging elements was hindered because BP and Transocean did not define key process limits or controls required for the drilling project. Hazard assessments of major accident risk on the Deepwater Horizon relied heavily on manual intervention by the rig crew to prevent catastrophic consequences.

I will use this illustration from the Presidential Oil Spill Commission to show you an example. It's based on the use of pipes called diverter lines, which are meant to help protect the rig from the consequences of a blowout. The rig is connected to the equipment at the ocean floor via a large pipe called the riser. At the rig, the top of the riser is open to the drill floor. Drilling mud is normally pumped down into the well and returns to the rig via the riser. However, instead of flowing out the top of riser onto the rig floor, it overflows into a section of pipe called the diverter line and into a mud gas line, which leads to equipment that will clean it up for reuse. If flow or pressure is high enough that the mud level might overflow, a device called the diverter packer closes like a big rubber doughnut to seal the top of the riser and force mud into the diverter line and the mud gas line.

In a blowout scenario, this mud gas system can be dangerously overwhelmed by the high flows of mud and flammable hydrocarbons coming up through the riser. The hazard is meant to be mitigated by opening one of two valves on the diverter lines. The diverter lines are designed to divert high volumes of mud and hydrocarbons over the side and away from the rig, lessening the chance of ignition. The design intent is if the hydrocarbons do ignite, they are further away from the rig crew and the rig's critical equipment. The CSB will be examining the adequacy of the diverter system in our final report. On the Deepwater Horizon, opening these diverter line valves has to be done manually by rig crewmembers. Each valve is remotely opened using emergency push buttons. However, relying on human reaction alone for such safety critical activities especially during an emergency situation with many distractions is not a safety layer with high reliability. On April 20, 2010, these valves were not opened. A more thorough hazard assessment by Transocean and oversight by BP might have identified the weaknesses of relying solely on worker intervention.

Particularly in a period of crisis, safety instruments and alarms might have been used to alert the rig crew to potential, the potential of overwhelming the mud gas system. Perhaps a safety management system or a safety system could have automatically opened the diverter valves. There may have also been other options but these were not evaluated for effective controls of hazards during the design of the rig and development of the safety systems. The next example of a safety system deficiency I want to highlight is the lack of written procedures. A key element in a proper safety management system requires that formal procedures must be maintained and followed for key process steps. An important part of the work on the Macondo Well was centered on verifying the barriers that were meant to keep hydrocarbons inside the well. One of these barriers was the cement that had been placed at the bottom of the well. This cement was supposed to plug the bottom of the well so that hydrocarbons could not enter. The final test of this cement job was the negative pressure test. The CSB in other investigations discovered that there were no written procedures for how to conduct a negative pressure test. There were also no written criteria or safe limits defined for determining if the test was a success or warnings on the consequences of deviation from the procedural requirements. If the procedural requirements could not be met, there was no instruction on

seeking engineering authority to proceed further. This was also an industry issue. No standards are guidelines addressed this safety critical procedure and the test was not required by the regulator.

As a result, on the day of the incident, there was a lot of confusion about how to proceed and so the test was conducted multiple times in multiple ways. Eventually, one of the crew proposed a novel, unsubstantiated theory about why the test results appeared the way they did. Eventually, the other crewmembers on the test crew were persuaded to accept this explanation. The test was inaccurately declared a success. A good procedure must contain the who, when, where and how of how to carry out key actions. It must also contain the appropriate warnings and cautions in case of an excursion above safe operating limits. Such was not the case for negative pressure tests done on the Deepwater Horizon. Informal test instructions did not specify safe operating limits for the consequences of deviating from them. It is not clear when one should seek supervisory or engineering approval to determine whether the deviation is significant and warrants further attention. Specifically, had normal negative pressure test ranges been established and consequences of a deviation made clear in a formal procedure, rig personnel might have viewed abnormal readings as serious infractions and sought additional help before erroneously determining the test was a success.

A third failed barrier in our Swiss Cheese model is management of change or MOC. So, when is MOC needed? MOC processes are tools for approving any work or processes that are new or have changed to operate outside of normal boundaries approved in existing hazard analyses. MOCs are also used to document the approval of any devices or systems that are not replacements in kind. What should an MOC contain? The MOC should be a package of documents which record the approval that risk analyses have been approved, performed and that associated hazards are mitigated, the documentation of change has been recorded, and to assure that new procedures and training have been completed. In contrast, the BP MOCs that have been provided to the CSB are simple one-page approval records; they lack any formal hazard assessments and lack verification that documents, procedures or training have been completed. The temporary abandonment process provides an example where lacking MOCs were associated with the April 20th tragedy.

Temporary abandonment represents the state of a well that has been left in a safe state after drilling so that a completion crew can subsequently convert the well into a producing asset. There is no documentation that has been provided to the CSB that indicates management of change procedures were completed on any of the following. Number one, the overall temporary abandonment plan was changed five times in the week leading up to the disaster. Each plain carried with it different risks and different obligations on BP and Transocean. No formal risk assessments were performed on any of the proposed changes. The unsuccessful cement job at the bottom of the well is the barrier failure that initially allowed hydrocarbon intrusion into the well. There was no formal testing or risk identification for various cementing options or for the appropriateness of the success of the final cement plan. The negative pressure test was described on the previous slide. It was a vital verification for the success of the temporary abandonment plan. If formal procedures had been in place, management of change processes could have been used to evaluate the risks in changing the procedures.

The primary purpose for conducting incident investigations as part of a safety management system is to determine primary causal factors and implement recommendations to prevent recurrences of incidents. Incident reports of near misses also raise awareness of the causes of potential hazards because they almost happened. The CSB found deficiencies in the incident investigations that were associated with the Deepwater Horizon. We present two examples. During the Deepwater, during December of 2009, an

incident that mirrored the events of the Deepwater Horizon took place on another Transocean rig. This rig is associated with a different operator other than BP. It is the Sedco 711 operating in the Bartolini field in Central North Sea. Like the Deepwater Horizon, the Sedco 711 Transocean crew had a delayed response to the indications that hydrocarbons were flowing into the well. Mud and hydrocarbons also reached the rig floor. However, in the case of the Sedco 711, flammable hydrocarbons did not ignite on the rig floor and the blowout preventer sealed the well, preventing a spill.

An operations advisory discussing the lessons learned from the Sedco 711 incident was prepared by Transocean but it was not fully communicated to employees beyond the North Sea. Neither was the internal PowerPoint presentation that was created by Transocean; it warned crewmembers that tested barriers can fail and that risk perception of barrier failure was blinkered by the positive info of that test. Crews outside the North Sea – for example, the Deepwater Horizon crew – could have learned from the Sedco 711 incident if proper incident investigation findings had been communicated. The near miss in the North Sea may have raised awareness on how trusted barriers such as the cement job on the Deepwater Horizon could fail.

A second example of a failure to share lessons learned (INAUDIBLE) an incident investigation occurred on the Deepwater Horizon itself only 43 days prior to the April 20th blowout. On March 8, 2010, a different instance of an unexpected hydrocarbon intrusion into the well bore occurred. The incident was not noticed for 33 minutes, which BP later deemed was slow and needing improvement. No explosion or spill resulted but significant drilling time was lost resulting in a delay. BP abandoned the well bore due to a stuck drill pipe in a bypass hole around the stuck pipe had to be drilled to continue the well. Even though BP thought the response was slow, the only formal investigation they conducted was an analysis of the geological conditions, which led to the intrusion.

They concluded that the Macondo formation was very different than those which BP had most of their prior experience. They proposed revised drilling practices going forward that would allow wells with Macondo type formations to be drilled with less chance of lost drilling time. BP did not effectively address the reasons for the delayed kick response by the Deepwater Horizon crew, neither was the response to the incident investigation formally investigated by Transocean. No findings or recommendations were generated. Internal BP and Transocean rig crew reviews were informal and verbal. The Transocean rig manager after discussion with the crew could not identify any changes for improving the response. Except for one person, the rig personnel involved in the kick detection and response on March 8th were the same individuals on duty on April 20th when the blowout occurred.

We have shown incidences – instances of inadequate safety management systems on the Deepwater Horizon. So, how can the performance of a safety management system be monitored? Indicators are a good tool. They can provide insight and alert personnel to settle abnormalities before a serious consequence can occur. Had indicators been identified and monitored for the safety management systems on the Deepwater Horizon, perhaps the incident could have been avoided. Let us now return to our Swiss Cheese model and suggest potential examples of pertinent safety indicators. These examples are meant to show how indicators can be developed to aid performance. To be clear, we are not proposing these specific indicators to necessarily be used, they are only presented as an example of how they could be used.

Number one, incident investigation especially into near misses provides tremendous leading indication of risk. A high frequency of near miss barrier challenges suggests misunderstood risk; it also

provides a warning into the normalization of deviance and acceptance that an activation of a safety barrier is normal. Given that both the Transocean Sedco 711 incident and the Deepwater Horizon March 8th incident involved delayed responses to a well kick, using a leading indicator such as the time to respond to actual indications of a well kick can provide important data to improve well control response. A proper hazard assessment should identify the initiating events that cause high consequence events. The associated risk should then be evaluated. The protection barriers that prevent the terrible consequences should be verified. A good leading indicator for this barrier could be the frequency of challenges to those protection barriers.

they are being challenged frequently, perhaps additional secured barriers are needed. Number three, hazard analysis and management of change will identify activities that are critical to safe operation. A good leading indicator could be the percent of the activities that have up-to-date procedures. Initially, this indicator could evaluate whether effective procedures exist. As a safety management system matures, the indicator could evolve to evaluate if procedure of verification and updates are happening at the proper frequencies. Comparing across different rigs, the number of MOCs completed during pre-engineered and plans activities such as drilling could indicate the health of management of change systems. A higher than average number of MOCs might suggest that the well is much different than anticipated and deserves extra oversight. Conversely, a lower the number- a lower than average number of MOCs could indicate that changes are being made on the fly, bypassing the MOC system. Regardless, an audit of the current versus original drill plan would point to the changes that should have been evaluated, also providing a leading indicator into the health of the MOC system. Our purpose again is not to suggest specific indicators for use offshore but to emphasize how indicators can be developed to improve safety system performance and to prevent potential catastrophic incidents like the Macondo.

These slides conclude the safety systems deficiency section. I'll now turn the presentation back over to Miss MacKenzie.

22 Offshore Safety Performance Indicators – Preliminary Findings on the Macondo Incident - CHERYL MACKENZIE

Safety management system deficiencies like those that existed at the time of the Macondo incident are most often symptomatic of larger systematic of larger systemic organizational problems. The safety approaches and key metrics used by Transocean, BP, offshore trade associations and standard setting bodies did not have sufficient focus on managing major accident hazards. It's interesting to note that in the wake of the Macondo incident, a number of oil industry and trade association spokespersons refer to the low recordable injury rate as evidence of the industry's overall successful safety performance. This reflects a continued over-reliance on personal safety metrics as a sole indicator of overall safety. A company's approach to safety is defined by where it focuses its attention and its resources. Some common methods that a company uses to focus its efforts on safety are site and business unit goals, employee performance contracts and job requirements for employees at all levels within the organization, reward and recognition programs such as bonuses and variable pay incentives that drive goal accomplishment, corporate leadership's focus in meetings, company performance reports and benchmarking activities, and the frequency and use of audits and inspections, the nature of the issues typically examined within them, the recommendations that result from such activities and the follow-through on needed fixes.

Paraphrasing safety expert Andrew Hopkins, the reality is companies and their employees tends to focus on goals and objectives, which are being measured at the expense of those that are not. Being overly focused on personal safety can lead to complacency about major hazards. The CSB's preliminary finding suggests that Transocean and BP's approach to safety demonstrate over-emphasis on personal safety at the expense of major accident prevention. Days away from work frequency and total recordable injury rate are common metrics used throughout industry both on and offshore. They are often promoted by high personal safety performance as an overall indication of the safety status of an organization; but research into safety metrics have clearly identified that such measures only represent one side of the safety coin, the personal safety performance.

Trevor Kletz, one of the forefathers of accident causation analysis, points out that, quote, “The last time accident rate is not a measure of process safety,” end quote. Yet these rates are so often touted as such. More often than not, the days away from work and total recordable injury rate data do not measure the low frequency, high consequence major accident events that cause multiple fatalities like the Macondo Well blowout. At best, personal safety metrics tell us how well a company is managing its personal hazards. I want to be clear that we're not suggesting that safety, personal safety programs are not important; they're vital for ensuring the safety of the workforce and to mitigate the personal hazards, they're vital. But that's not sufficient for the prevention of major accidents.

We will discuss preliminary evidence that suggests that an inappropriate focus on personal safety metrics as a measure of process safety performance contributed to inadequate safety management approaches by Transocean, BP, and others; and that it was this inappropriate focus that set the stage for the Macondo disaster. After the Baker Panel and CSB Texas City investigation reports were published in 2007, BP pledged to implement its new safety operating management system, or OMS, throughout its cooperation- corporation. This was a large initiative that sought to transform the company's approach to safety. The OMS contained process safety elements, some of which hit upon the failures that came to light when the Texas City incident occurred. It was to replace the Getting Health, Safety and Environment Right program which one BP executive said, quote, “Was largely around personal safety.” This in fact

was a major of the CSB in its investigation of the Texas City incident. However, by April 2010, OMS was only partially implemented into the drilling sector. When asked about the OMS rollout in the Gulf of Mexico, a high level BP manager stated to the CSB, quote, "We were just getting started."

BP drilling and wells completion personnel stated to the CSB that BP safety focus and audits, reviews and safety scorecards primarily addressed personal safety issues such as days away from work, recordable injuries, and dropped objects. Many of BP staff are unfamiliar with process safety management concepts or the need to have a specific focus on major accident prevention. Witnesses stated that personnel contracts just prior to the incident focused on safety criteria such as recordable injury rates, days away from work, and the implementation of OMS. Indeed, key leaders of BP's drilling and completions grouping held periodic leadership team meetings to review important performance data of its various global locations including the Gulf of Mexico. It is significant that when they reviewed safety performance, they focused on personal safety statistics. Post-incident, BP's own investigation report contained a number of recommendations for process safety improvement including the establishment of leading and lagging indicators for well integrity, well control, and rig safety critical equipment.

BP did not conduct an effective comprehensive hazard evaluation of the major accident risks for the activities of the Deepwater Horizon rig or for the Macondo well. According to its major accident risk assessment for Deepwater Gulf of Mexico, BP conducts major hazard evaluations of it's own facilities to, quote, "Focus on the continuous reduction and the risk posed by major accidents," end quote. The results of this important assessment are reported to business segment leadership and if the findings suggest safety issues of significant magnitude, they are communicated to the group level within the organization. This is one of the highest levels within the corporate management. However, the major accident risk assessment looked only at BP assets, not drilling rigs that it contracted for and with.

Additionally, BP developed a risk matrix highlighting the various risks the company faced in its offshore endeavors. The risks identified in the matrix focused on financial risks, not process safety risks. Post-incident, BP's Deepwater accident investigation report recommended requiring hazard reviews of BP-owned and contracted rigs. BP's 2009 performance review of Transocean's rigs' safety performance, including the Deepwater Horizon, focused on operational performance, dropped object incidents and equipment failure. Other areas of focus were number and duration of downtime when the rig wasn't drilling and benchmarking production performance to others within industry. Total recordable injury rate and serious incident or injury rate were highlighted as major safety performance metrics delineating the state of safety at BP's ___, BP's contracted and Transocean maintained facilities. In its 2007 audit of the Deepwater Horizon, almost all of the recommendations focused on personal safety issues. These included waste handling, scaffolding, appropriate tank container labeling and equipment calibration.

Post-incident, BP's Deepwater accident investigation report recommended that hazard reviews be included as an explicit check in rig audits. At the time of the Macondo incident, BP personnel performance contracts did not typically contain process safety metrics other than the completion targets for OMS implementation. Personnel safety was rewarded, overshadowing major accident hazards. For example, BP and Transocean VIPs were on the rig at the Macondo well at the time of the incident to celebrate seven years of zero lost time incidents. They also came to discuss a slip hazard that had occurred at another rig to make sure the lessons were transferred and one of the executives spent a significant portion of time inspecting harnesses to ensure that they were being tagged and maintained (property). Despite having drilling expertise, the VIPs focused their attention and limited time on the rig to personal safety issues.

BP did collect leading and lagging indicators in a high level document of risk trends called the Orange Book that was shared with top executives. However, like their major accident risk assessments, the focus was on BP-owned assets. Post-incident, BP has developed a more rigorous process safety indicators program with both leading and lagging indicators. Transocean's health and safety manual states that key tools within its health and safety management system are its Think and Start programs. These behavior-based safety tools focus on the efforts of the rig crew to plan a work task and the behaviors used to carry them out. These tools are primarily focused on managing personal risk, not major accident risk. (INAUDIBLE) completions have been identified by Transocean as a key performance indicator and include it as a corporate measure for rig performance. This is not just the case for the Deepwater Horizon rig. The UK health safety executive in a recent organizational and human factors inspection of five Transocean facilities in the North Sea confirm that the company's use of these programs as their primary means of measuring safety performance and HSE documented a strong concern about their over-emphasis in the safety management program.

In 2004, Transocean's major accident hazard risk assessment of the Deepwater Horizon made 27 recommendations for safety improvements. Almost all addressed personal safety issues. Twenty-three of the recommendations pertain to improvements, to warning signs, PPEs, storage lockers and disposal containers. Three other addressed needed equipment improvement such as to the public address systems. One addressed the need for more training. None of the recommendations addressed major accident risks such as gas in the riser or well blowouts. Post-incident in describing their safety systems, Transocean executives highlighted the fact that they had implemented a major accident risk assessment program across all Transocean operations. Within Transocean's major hazard risk assessment of the Deepwater Horizon that was conducted pre-incident. The scenarios of blowout or gas in the riser were rated as high severity, however, they were rated as negligible to low in likelihood. The important point of this logic is that one must have a robust system of barriers or layers of protection to prevent a blowout, otherwise the likelihood would be far greater.

Unfortunately, the preventative measures listed within the risk assessment for blowouts and gas in the riser focused on procedures, training and instrumentation of VOP controls that largely required manual activation by the crew onboard. Humans are fallible and as such are often not enough as a sole barrier when it comes to major accident risk. Transocean Asset Management Handbook states that key performance indicators are used to evaluate and benchmark performance. The KPIs are determined by corporate and regional departments and they are used to develop regional-specific goals and objectives focused at achieving compliance and improving performance. As you can see, the metrics being used are almost exclusively personal safety performance indicators. As part of its public reporting to the Securities and Exchange Commission, Transocean discusses how it measures safety performance and prevents actual performance through annualized statistics. Transocean measures overall safety through two metrics: the total recordable injury rate and total potential severity rate.

The TPSR is a proprietary measure. According to the Transocean Asset Management Handbook definition, its potential severity per incident metric, quote, “Relates only to potential personal injury,” end quote. Despite giving itself a zero score in the total recordable injury rate because of the eleven-fatality Macondo incident, Transocean's total potential severity rate score was such that its top-level corporate executives received financial bonuses for the company's safety performance. Safety was rewarded despite the company's experiencing a large multi-fatality incident with devastating economic, environmental, and human consequences. When the CSB approaches an incident investigation, it examines and incorporates

not only the regulatory standards but a broad array of recommended practices and guidelines in the US and internationally in order to best understand the progress and continuous improvements that are taking place among industry and regulators globally to prevent such incidents.

The work influence of two important industry associations are worth discussing here. Yesterday, we heard about CSB's evaluation of API Recommended Practice 754. This guidance document is a significant and positive step forward in the offshore safety performance indicators – excuse me – in establishing onshore safety performance indicators. However, API 754 does not explicitly apply to offshore operations. We noted that the focus on infrequent lagging events results in an incomplete picture of a company's safety status. Additional leading indicators, both onshore and off are needed to improve our abilities to successfully manage highly complex and hazardous work environments. There's a need for expanded reporting requirements, including leading indicator data so that industry can not only benchmark its production performance and its personal safety performance but also its process safety performance. API 75 is a safety and environmental management program recommended practice that applies to offshore operations. It includes an appendix that addresses safety performance measures.

The listed performance measures for collection by the company are optional, using words such as consider, and focuses on personal safety metrics and infrequent lagging indicators. In the next section of the presentation, we will discuss in more detail the performance measures provided for an API's Recommended Practice 75, which is now SEMS and recent rule making by the offshore regulator. Finally, I'd just like to talk about IADC, which is the International Association of Drilling Contractors, another industry association with global membership. The IADC has a rig recognition program that is based on personal safety statistics, giving specific recognition to the rigs that achieve a one-year period without a lost time incident rate and a total recordable incident rate of zero. Process safety is not a criteria for the IADC rig recognition award and process safety events are not asked to be reported. IADC's focus on personal safety is also shown in its publication *Health, Safety and Environmental Case Guidelines for Mobile Offshore Drilling Units*, of which the Deepwater Horizon was one.

Broken down into numerous sections, the safety case guidance publication appears to be comprehensive. However, there is a lack of guidance on safety performance indicators in the context of major accident prevention. Other than calling out for the need of both of reactive and proactive indicators. The guidelines do not provide details on how to select, collect and use indicators data. There's also no mention of potential indicator examples, attributes of effective indicators, whether these indicators should be reported to the IADC or how the IADC plans to use the data. I am now going to turn the presentation over to Mr. Holmstrom.

23 Offshore Safety Performance Indicators – Preliminary Findings on the Macondo Incident - DONALD HOLMSTROM

We're now going to turn to our examination to the role of the regulator in driving safety performance. The offshore safety regulator is now called the Bureau of Safety and Environmental Enforcement or BSEE. At the time of the Macondo incident, the Minerals Management Service or MMS was the name of the regulator, the regulated offshore safety in the Gulf. We must note at the start that BSEE has taken positive initiatives post-Macondo for advancing regulations. The CSB will be examining regulatory issues in our final report; in particular, we'll be looking at issues related to the safety case and regulatory coverage of contractors. Looking at pre-incident events, BP was one of the finalists for a 2010 high OCS activity award, a safety commendation from MMS. But MMS decided not to give any awards after the Macondo incident in 2010. BP had previously received several MMS safety commendations, most recently in 2009 when it received the National SAFE award.

MMS awarded the Lafayette District award to Transocean in 2008. Both companies have received multiple awards for their safety performance from MMS since the program's inception. In total, BP received nine awards and Transocean received six. MMS established the Safe award in 1983 to recognize companies that enhance operational safety and environmental protection in the outer continental shelf. Award criteria for nominees included accuracy of record-keeping, training, equipment maintenance, cooperation with MMS, and utilization of new technology. The award recognized stellar personal safety performance such as prevention of lost time injuries and few days away from work, but it did not address the health of a facility safety management systems to control major accident risk.

Prior to Macondo, the MMS incident reporting rule required leaseholders and operators to report primarily personal safety-related events such as fatalities and personal injuries plus events that are infrequent lagging indicators like losses of well control, fires, explosions, collisions and incidents that damaged or disabled systems or equipment. However, these requirements are much more thorough than what OSHA requires onshore, for onshore oil facilities to collect which are based on personal injuries. MMS posts data in an aggregated form on its website. At the time of the incident, MMS requested leaseholder operators to report certain outer continental shelf performance measures on a voluntary basis. On MMS form 131, operators were asked to give the number of blowouts, fires and explosions, drilling and productions incidents of noncompliance, oil spills and injury and lost time work-related data.

The MMS also published this data in a sanitized aggregated form on its website. The results of the voluntary reporting in some lagging indicators showed very infrequent incident rates. Taking a look at some of the data collected from BSEE's incident reporting rules since 2006, we see that loss of well control events that are reported are infrequent. Because BSEE defines the loss of well control as the uncontrolled flow of formation or other fluids, and per their definition, the flow may be an exposed formation, an underground blowout, or at the surface, a surface blowout, it could also be through a diverter or an uncontrolled flow resulting in a failure of surface equipment or procedures. This definition of well control event captures more serious events closer to what is akin to a blowout and increases in pressure in a well which is known is known as a kick in the industry if it unintentionally results from fluid coming back into the well that requires an unplanned contingency or well control response to maintain or regain control of the well.

So, although the BSEE loss of well control metric is a process safety indicator, it only covers a small subset of potential process safety events, no more than eight events per year in the Gulf of Mexico over the last years. If you think about the amount of drilling activity in the Gulf, most operators will have zero losses of well control each year. These numbers are too infrequent to drive incremental improvement or lend themselves to trending data. BSEE'S incident reporting requires operators to report unignited gas releases that initiate equipment or process shutdown. Operators must also report all hydrogen sulfide releases that result in a 15-minute time-weighted average atmospheric concentration of H_2S of 20 parts per million or more on the outer continental shelf facility.

Again we see here the result has been that most companies probably experience zero of these types of gas releases each year. There were never more than 17 gas releases per year over the last six years. If we were to use a performance metric that required reporting of all hydrocarbon releases beyond incidental events, the CSB believes there would be a larger number of incidents reported. A larger amount of data would allow operators to make incremental safety improvements and watch out for potentially dangerous trends to indicators accepted by most – and watch out for potentially dangerous trends similar to indicators accepted by most of the same companies operating in the North Sea.

Turing the rule-making process of 2006, MMS proposed that operators report any unintentional gas releases that could raise hydrocarbon or other gas concentrations to the lower flammable limit but industry objected that would be overly burdensome and serve no purpose in improving safety on platforms. MMS disagreed but simplified the regulation to require only gas releases that result in equipment or process shutdown. As we can see, the resulting metric has little utility to drive performance improvements. In February 2011, outer continental shelf performance measure reporting became mandatory along with BSEE'S Safety and Environmental Management System or SEMS rule. The same data points, once voluntarily collected on MMS form 131 is almost identical to the performance measures recommended in Appendix E of API Recommended Practice 75.

Although mandatory reporting requirement is an improvement, it still represents a reactive form of risk management. Most of the indicators that must be reported to BSEE are lagging like fires and explosions or personal safety incidents like recordable injuries and illnesses. If operators rely on these data points as performance measures, as we said yesterday, it's like driving a car down the road looking out the rearview mirror. These indicators are useful for measuring and comparing personal safety, but as we've discussed, personal safety and process safety are two very different goals that require different indicators, both leading and lagging. Companies and trade associations and trade groups operating at other regulatory regimes, as I think we'll hear later today, provide examples of what are perhaps more effective indicator programs recognizing the value of leading indicators and using them to drive continuous improvement. Trade associations and many of the same companies that operate in the US Gulf of Mexico are partnering with international regulators to advance these programs.

In the United Kingdom, for example, the regulator works with a tripartite group that has established three performance metrics and targets for improvement such as reducing hydrocarbon releases by a certain percentage each year. Norway's Petroleum Safety Authority or PSA also partners with industry groups and unions in a program to collect a number of leading and lagging indicators, they assess the health of well safety barriers and other leading and lagging performance metrics. After talking to representatives from some of these international regulators and industry groups, we've heard about several model process safety indicators that currently are in use and we provide these as an example of indicators that are used in these programs. They include checks on safety-critical equipment, unplanned shutdowns,

hydrocarbon releases, number and duration of out of service equipment or use of temporary equipment, timely management follow-up to safety recommendations.

And I'm sure you'll hear a lot more about this later today. As we explained yesterday, it's important that performance measures are reported consistently and accurately. In the Gulf of Mexico in drilling operations, most of the companies and workers that experience recordable events are contractors, not actually employees of the leaseholder or the operator. This raises an important policy issue of where they're placing regulatory responsibility on offshore parties including contractors is necessary to ensure consistent and accurate reporting of data. Post-incident, the offshore industry has disputed how much offshore contractors or subcontractors are legally responsible for compliance with BSEE regulations. For the first time ever, the Department of Interior has issued citations directly to two contractors, Transocean and Halliburton as a result of the Macondo incident. Until then, the general practice was that operators were responsible for the conduct of contractors they hired.

Any contractor's noncompliance with MMS regulations would be the responsibility of the operator. So these citations were a marked departure from that norm and are as we understand being contested. The new SEMS rule explicitly notes that contractors, that some contractors are not necessarily required to have their own safety and environmental management system; instead, operators are required to document their contractor selection criteria, contractor training, safety record and safe work practices and to be (prepared) for contractor audits. So, although this new regulation does consider contractor involvement in more detail than previous regulations did, it does not carve out specifically legal requirements for contractors to adhere to. A more clear delineation of contractor rules and regulatory requirements would benefit offshore industry and the regulator.

Conclusions. Since the release of CSB's BP Texas City and Baker reports, progress has been made onshore to focus on process safety and the use of leading and lagging indicators. The offshore oil trade associations, companies like Transocean and BP and the regulator, however, have not sufficiently learned nor effectively implemented these vital safety lessons from the two events. Industry, management, and the regulator and the workforce must work together to develop more effective process safety and indicator programs for offshore energy operations. Mr. Chairman, that includes the staff presentation on the Macondo incident and use of performance indicators to help prevent offshore potential catastrophic accidents. Thank you.

24 Questions & Answers by CSB Board, Staff and Public

24.1.1 RAFAEL MOURE-ERASO

Thank you very much. Well, at least from the point-of-view of the Board, I would like to give you a round of applause for the report. In the interest of time, I am going to ask my board member colleagues to keep our questions from the board at a minimum. So, Mr. Bresland.

24.1.2 JOHN BRESLAND

Thank you, Mr. Chairman. A question for Mr. Holmstrom. Just to clarify for myself and for the audience, there were at least two parties involved with this and certainly the two parties that you have talked about most are BP and Transocean. Who exactly is responsible for the safe operation of the offshore rigs?

24.1.3 DONALD HOLMSTROM

I'm glad you asked that question. And there is somewhat of a difference between the regulatory requirements and what might be termed to be good practice guidelines and other influences. The regulatory requirements from the Outer Continental Shelf Lands Act placed – and have historically placed pretty much exclusive authority on the leaseholder operator for the safe conduct of exploration and production activities in the Gulf of Mexico and elsewhere. That being said, post-Macondo as we mentioned in our presentation, there have been some fines that have been levied to two contractors – Transocean and Halliburton. What the eventual legal decisions will be made because we understand that's contested we do not know. But we think those issues are important to resolve. I would also note that our understanding of the International Association of Drilling contractor safety case guidance, for example, places the major hazard risk of drilling operators, drilling activities on the drilling contractor in that safety case guidance. And clearly those activities are conducted by the drilling contractor and it's important the drilling contractor, even though they my or may not under the current interpretations of both the statutory and regulatory scheme have be deemed to be having regulatory requirements and responsibility. It's certainly good practical suggests that they have major accident risk responsibilities in the drilling operation.

24.1.4 JOHN BRESLAND

What's our current situation with Transocean?

24.1.5 DONALD HOLMSTROM

Our current situation is Transocean in the first couple of months of our investigation, Transocean was cooperative in terms of providing documents. Approximately September of 2010, Transocean took the position they questioned whether the CSB had jurisdiction to investigate the incident. The CSB issued a number of subpoenas that were contested by Transocean. The CSB sought to enforce those subpoenas in federal district court here and the South Texas district. And oral arguments were held in front of the federal district court in April of this year and we're awaiting a decision in terms of whether or not our subpoenas will be upheld, or really the question is whether the CSB has jurisdiction from Transocean's perspective.

24.1.6 JOHN BRESLAND

Okay, thank you.

24.1.7 RAFAEL MOURE-ERASO

Thank you, John. Mark.

24.1.8 MARK GRIFFON

Thank you, Mr. Chairman. Yeah, I just have one question with seven parts. No, just kidding. I'll keep it short. In the presentation, you mentioned that the risks were not properly managed by BP and Transocean. I believe that was the quote. Also on slide 29, there's a mention that they primarily focused on financial risk and I'm interested in looking at a lot of the materials that have been out so far and a lot of the discussions that have been ongoing. There's been a discussion of commercial risk compared to safety risk and sort of the mindset in the offshore sector in addressing these two risks. And I'm wondering if there was any attempt prior to or now to link these risks. I mean it appears to me that if depending on how you modeled it and how you assessed it, financial risk is inexplicably linked to these major hazard risks as well. So I'm just curious if they made any attempt to link these two.

24.1.9 DONALD HOLMSTROM

You know that's a great point. I could just first clarify that this was the use of their risk ranking metrics on page 29. In their well planning process, BP had a well-known, a very elaborate well planning process called "Beyond the Best," and in the course of that, one of the requirements was a risk ranking process and the risk matrix had impact columns that discussed cost and schedule in terms of the risk ranking. We have learned you know that post-incident in BP – it's in BP's report that they believe that tools like hazard evaluations, haz-ops risk ranking, etc., risk assessment will be conducted on all their wells. That was one of their major recommendations that came out of the report. So, I know within the exploration and production community, maybe, perhaps there have been debates about whether haz-ops are appropriate on drilling rigs; but, clearly, BP is indicating that they are going to do that and we believe that they're going to be doing that, they've told us both on their own assets as well as contractor facilities. And we, and we're going to explore in more detail in our final report how tools like hazard evaluation – and there's a variety of tools that can be used – can be effective for decision-making, not only during the course of planning a particular well but also in the design of rigs and decisions that are made much earlier in the process that can have a preventative impact on major accident risk.

24.1.10 MARK GRIFFON

Thanks. And just one other question – oh, Cheryl, did you have – I'm sorry.

24.1.11 CHERYL MACKENZIE

I was going to add to that. And I think that your question is a good one that you know safety risk and financial risk are often very much entwined. And I think that part of the concern that we try to raise in this PowerPoint is that if a company's approach to safety management is not to give it enough significance in what it's focusing its attention to in leadership meetings and leadership goals and objectives as it does for its financial risk, then that's where the problem occurs, but if you're doing both, then you should be managing both.

24.1.12 KELLY WILSON

And I think in addition to that, the barriers and mitigations that you would put in place for the two different kinds of risk, while they might be identifying the same risk, a safety barrier and mitigation would be different than a financial risk barrier and mitigation and that would be the distinction.

24.1.13 MARK GRIFFON

And Cheryl might have stepped into my next question which was from an organizational standpoint, I'm just curious where BP and also Transocean where their safety program was situated organizationally. It seems like there was a lot of focus on al safety versus process safety. I'm wondering if the safety department, safety program had responsibilities in the process safety area or were they focused primarily on the occupational health personal safety area.

24.1.14 DONALD HOLMSTROM

I'll just say first that some of the evidence we have for this is not only documents and interviews with some Transocean workers, but as you might imagine given the dispute, we don't have access to all the Transocean workers. But we have had access to some and certainly there's a number of board-level documents that we have that indicate that at the board level, there's a focus on personal safety. So it seems to be at all levels of the organization including their activities, their metrics and their risk evaluations are primarily focused on personal safety risk.

24.1.15 MARK GRIFFON

Okay, thank you.

24.1.16 RAFAEL MOURE-ERASO

Thank you, Mark. I just have a very fast question. On the data from BSEE that you reported on losses of well control and on ignited gas releases, what is the denominator, I mean how – we're talking about how many instances they found. For instance, in 2011, only two losses of well control or in 2010, two unignited releases. I mean how many wells are we talking about that were examined to come out with that number?

24.1.17 DONALD HOLMSTROM

Well, we can get those – we can get those numbers for you.

24.1.18 RAFAEL MOURE-ERASO

Now then I would like to continue opening the floor for discussion from the public to questioning the investigative team and I will ask Dr. Horowitz to please facilitate the questions.

24.1.19 DAN HOROWITZ

A reminder there are three ways to ask questions or participate. I see some cards out there, so we'll send a staff member around. There are three ways to participate. You can email your question to question@csb.gov and you can fill out a card, which I see some people, or you can come up to the microphone. Let me start with a couple of questions that were emailed. And I would remind folks joining

us via our webinar that they are also welcome to email their questions in to question – singular – at csb.gov. And we'll attempt to cover as many as we can. The first question comes from Douglas (Minema) I believe it is with the Defense Nuclear Facility Safety Board, which we heard from yesterday. And the question is: *The team presentation noted that BP's major accident risk assessment only looked at BP assets; however, it appears that most of the higher risk operations in the oil exploration industry are contracted out. Could the team comment on what fraction of BP's high-risk operations are actually conducted with BP assets and would be covered by this major accident risk assessment. In other words, how much of BP's operations would not have been captured in this assessment?*

24.1.20 KELLY WILSON

It's my understanding that BP assets include production facilities and associated drilling that would occur around those production facilities immediately. Exploration drilling that would be contracted out to a drilling rig such as a jack-up rig or a MODU like the Deepwater Horizon would have been done under a contractor. I don't have a feel for the exact percentage that that work is versus production, but every time a well is started up, there is exploration drilling first and then it would transition to the production and drilling around a production to increase production.

24.1.21 DANIEL HOROWITZ

Thanks. The next question comes from David (Newtson) and he writes: *Since these incidents, has BP taken on any safety programs; if so, can you speak on them and what they provide to BP.*

24.1.22 DONALD HOLMSTROM

Yeah, we have actually – that's a great question – we've met with BP several times. We've met with Mark (Bly) and his group, his new organization and we've had a presentation on their indicators program. And, first, I'll just say it appears to us that BP in their presentation is planning and initiating an elaborate indicators, performance indicators program that covers and addresses major accident prevention and addresses across their operations leading and lagging indicators. And so I think it appears to be positive development. And I think also we understand that they have, you know they have a new organizational focus and have created a new organization internally that is focusing on making sure their major hazard risks are being addressed and they're playing an active role throughout their organization. So, there have been some significant changes in response. You know as the Chemical Safety Board, we respond to incidents; we don't provide endorsements. And you know sometimes unfortunately we respond to future incidents. So, you know we could just observe that the presentations and the information provided is certainly a positive step forward.

24.1.23 DANIEL HOROWITZ

And the next question is: *The Department of Interior is involved with offsite regulation. Are they represented here?* Perhaps I'll just answer that myself. There are represented here through their staff and in addition to that, we've had a number of positive interactions with the new director, Admiral Watson. We did invite him here. He had a schedule commitment, he could not make it but we hope to continue these interactions as we pursue our further work on safety indicators. And why don't we see if there are – go ahead, Sir, why don't you come to the microphone and do say and spell your name.

24.1.24 COLIN LEACH

My name is Colin Leach, L-E-A-C-H. I'm with Argonauta Drilling Services here in Houston and I've certainly reflected on well control for a good few years and appreciate the presentation. My question is has there been enough emphasis on establishing what is normal and that is from the point-of-view that once you established what is normal, then a drilling crew or an operations crew can much better recognize what is not normal.

24.1.25 KELLY WILSON

I think that's an important idea. I mentioned earlier that with procedures with safe operating limits, a crew can easily identify when they're going outside of safe operating limits and would either have to get an MOC for some sort of change or seek engineering authority. But I think establishing safe operating limits or what is normal is an important step for crews being able to do that.

24.1.26 DONALD HOLMSTROM

I would add that the CSB approach is to examine multiple opportunities for improvement. And, typically in an incident investigation, we look at not only at improved decision-making or how the workplace can be changed to improve key decision-making on the rig or in another workplace, process workplace that we're investigation and how performance can be improved – that's obviously a key element. We have an emphasis on human factors, which is going to be part of our final report. But we also we think it's important to look at decisions that were made earlier in the decision-making chain of developing your safety management systems, designing the rig. And certainly we take the perspective that's widely acknowledged throughout the – I think the realm of process safety as well as occupational safety of the hierarchy of controls, that changes to design, engineering, removing hazards, inherent safety are at the top of the hierarchy of controls. And things like procedures, training and PPE and things of that nature are often important but are less effective in preventing major hazard accidents than the other elements that are at the top of the hierarchy of controls. So, this has been a major feature of major accident analysis for the last 30 years and certainly one that we apply. So, we do look at all those elements; we don't just look at the top of the hierarchy but we certainly recognize that the hierarchy is very important and that's why we are in our final report, we are going to be focusing on what appears to be an emphasis on manual control and manual intervention for well control and whether things like the driller control system interface, safety instrumented systems and other automatic controls and interlocks, which certainly are used on the dynamic positioning systems in rigs, and whether those can be applied effectively to drilling. These are all things that we're going to look at. So, we have both emphasis but we follow the hierarchy of controls – if that helps answer your question.

24.1.27 DANIEL HOROWITZ

Mr. Chairman, we have about five more questions that we know of so far. Would you like to continue the discussion?

24.1.28 RAFAEL MOURE-ERASO

Why don't we go to half of them and then we'll take a break and prepare to do our panels.

24.1.29 DANIEL HOROWITZ

Okay. Maybe I'll just ask the – a lot of them are very brief, so if I ask the staff to just do a brief answer, I think we could probably get through in just a couple minutes.

24.1.30 RAFAEL MOURE-ERASO

Okay.

24.1.31 DANIEL HOROWITZ

The next question is: *Most people in the room know or can figure out how to do PSM right. The key issue seems to be why companies are not doing PSM right. The root cause is lack of full company commitment to it. The real question for this hearing is why this lack of full commitment to PSM. Has that aspect been explored. And perhaps I'll just ask you to say briefly what you're going to do in the next six months.*

24.1.32 DONALD HOLMSTROM

Just briefly. You know I think that's an important issue and I think the CSB is uniquely situated from our Texas City report to look at organizational issues and also one of those issues is corporate governance and corporate oversight over major hazard risk and health safety and environmental issues. And we addressed this issue in our BP Texas City report and we made a recommendation to the board, several recommendations to the board of directors at BP. And that's certainly an issue we're going to revisit because it's important that these issues not be addressed at the top of the corporation.

24.1.33 DANIEL HOROWITZ

Next. Did BP safety personnel report to the project managers or were they independent. The question is: *Did BP safety personnel report to or through the project managers or were they independent*?

24.1.34 DONALD HOLMSTROM

That's, I think that's a great question. It sort of reveals, it kind of reveals some of the organizational issues we'll be examining in our final report. There was a change in BP's safety oversight that was occurring right in the weeks before the incident occurred. In fact, it was transitioning within just a month or two before the incident occurred where there was a transition; actually, it was part of the OMS transition where certain safety functions, particularly engineering functions and process safety functions were moving to what's called a separate and more independent engineering authority. That transition had not occurred at the time, completely at the time, it was in transition at the time of the incident.

24.1.35 DANIEL HOROWITZ

The next from David Evans of Petrofac. *When developing a bridging document, does the CSB consider that the document should present a fully integrated safety management system for the project?* Somewhat of a rhetorical question I guess.

24.1.36 KELLY WILSON

In looking at the safety or at the bridging document safety management systems, we felt that they should both address the differences in the safety management systems between the contractor and the

operator, and they should also address rig and location project specific risks and things that might be new or different for that location and project than for a different location and project.

24.1.37 DANIEL HOROWITZ

All right. Jim Lefton of the USW District 13 writes: As with yesterday's discussion, it appears this industry is doing a very poor job of regulating itself. *Does the CSB intent to recommend to Congress the formation of a regulatory agency to stop the industry from continuing to regulate itself,* he writes. Obviously, just briefly, that question of any regulatory improvements that we can develop is something that we will certainly consider in the final report.

24.1.38 DONALD HOLMSTROM

Daniel, I would just add one thing. One of our recommendations for the BP Texas City report is in essence is that the regulator has to be as competent technically and know the industry as people in the industry do. And we pointed out that both in Contra Costa County in the United States and also the UK HSE, there is more frequent highly technical inspections by a larger technically competent group. So, an independent technically competent regulator is something that is very important. And that was one of our major findings from our BP Texas City incident. So, we're going to be looking at that issue in this case.

24.1.39 KELLY WILSON

I think this is also an answer to the earlier question about why companies aren't enforcing or using PSM effectively, and I think a strong competent regulator that it's now especially since it's going to be enforced through SEMS that is going to be challenging in working with industry to develop strong safety management systems.

24.1.40 DANIEL HOROWITZ

Michael Holtzer writes: *Much discussion has taken place around the blowout and prevention of a future incident, but little around the ignition around the hydrocarbons. In your investigation, how much focus was put on the emission point and the equipment and hazardous areas?*

24.1.41 CHERYL MACKENZIE

We're still exploring a number of issues with our investigation, our full investigation report. But I think that a common approach when we look at these incidents is that we make the assumption that ignition sources are there, that you can't prevent every ignition source from existing. And, while it's good to put design and systems in place to prevent ignition sources, that it's more important to keep the hazardous chemical in the pipe, so to speak. And what are the mitigation and barriers to prevent that from occurring. And that's what we often focus our energies on examining new safety advances in those areas.

DANIEL HOROWITZ

And, as I understand, the diversion of hydrocarbons, though, into an area where there were ignition sources is an issue that we were examining.

24.1.42 CHERYL MACKENZIE

And, right. As Kelly discussed in the PowerPoint about the diverter system, that's one of the areas where we are examining a safer placement of the hazardous materials.

24.1.43 DANIEL HOROWITZ

Right. Okay, very good. And what was the main reason – and perhaps this will be the last one – *What was the main reason for over reliance on manual shutdown emergency procedures by operators instead of automatic systems?* And that comes from Ankur Pariyani of Near-Miss Management.

24.1.44 DONALD HOLMSTROM

We've asked this question quite a bit around- around the Gulf of Mexico and around the world, actually. And I don't think we have – we've heard a lot of different answers. I think, though, that it's an important issue for us to explore. I worked for many years in the oil refining sector and certainly when we instituted DCS controls and automatic controls and interlocks and safety systems, they were highly debated as to how they would interrupt production or how they would disrupt processes. And but I think the industry finally accepted they were absolutely critical to prevent major accidents. I think that's an important discussion to have is the over reliance on manual control versus systems that can either provide more accurate and urgent information to the drillers and workers of the conditions that are developing or have designs where there are interlocks and controls that prevent those systems from taking place.

24.1.45 DANIEL HOROWITZ

Mr. Chairman, if it's all right with you, let's take one or two from the floor and then we'll defer the rest for another Q&A period if that's okay.

24.1.46 RAFAEL MOURE-ERASO

Yes. From the floor.

24.1.47 DANIEL HOROWITZ

Go ahead, ma'am, and please say your name and spell your name.

24.1.48 CHERRI FOITLIN

Sure. I'm Cherri Foitlin (spells). My husband is an oil worker in the Gulf of Mexico. So, my job here just for a second, I just want to say, I just want to remind you just to make sure that everybody here knows this, when you're talking about risk assessment, you're really just talking about life and death. And I just want to make sure that when you say "risk matrix," you're saying "life and death matrix." And when we're talking about incidents, we're talking about the death of people, right. So, I just want to make sure that whenever we talk about this, we're being very clear about what we're speaking about. This is very important stuff. And I really appreciate the report you put out. I think it's accurate. I think it's just great work. But I have a couple of questions. And one of them is the regulation of industry policing itself and the fact that it feels like you don't have any really teeth because if you basically gave the same recommendations during the Texas City refinery disaster in which 15 workers died and then you're saying basically the same thing again. And I understand that you can make recommendations like the EPA. But when is there a level of teeth come in where you are actually able to alter what's happening within the

industry itself? That's one question. And then the last question is there going to be some kind of approach to the chemicals that were used on the spill itself on a subsea level and then on top of the water, because living in the Gulf of Mexico, I know maybe thousands of people that consider themselves ill because of the use of these chemicals. And, is there going to be another report based that works on that?

24.1.49 DANIEL HOROWITZ

The second part of your question, ma'am, just due to the scope of this accident, we had to draw certain boundaries when we started two years ago. So, the aftermath and the emergency response and the use of dispersants is outside of our scope of work, unfortunately. Well, I know EPA and others have looked at those issues and we can certainly follow-up with you during the meeting on that. But on your first question, I'll ask the team to respond.

24.1.50 DONALD HOLMSTROM

Just quickly, I think it's a great question. We often get that as an agency that makes recommendations but we do you know we impact safety through persuasion and urging improvements based on the powerful findings from our investigation and our factual findings and our analysis. And, so, we have, at the CSB we have certainly made a difference in a lot of areas and it's through I think our recommendations advocacy and follow-up program. We have a separate program in the agency. Once the Board makes a recommendation, those recommendations are followed up, they're assigned a status and we have a crew of employees in the CSB who follow-up on those recommendations and Board members advocate for those recommendations. And, so, through that mechanism, we work as you might have seen yesterday with API 754. We (INAUDIBLE) step forward but there is more things that need to be done. And our recommendation staff and our board will be pursuing those issues to make sure that improvements are made. And so that's how we do our work and we're not always successful but we've made some significant contributions I believe.

24.1.51 CHERRI FOITLIN

So, the mechanism failed for Texas City.

24.1.52 DONALD HOLMSTROM

Well, I think some things have yet to be sufficiently changed and I think other things have been successful. A couple of examples are trailer siting. It was mentioned earlier that all of the 15 who died were in and around trailers. And the industry has implemented recommended practices to remove trailers from hazardous process areas; and that's been very effective. We could mention a number of other areas but there have been some successes. I think people realize the hazards of atmospheric vents. In this case, it was a blow-down drum and stack that released flammables to the atmosphere, which can be heavier than air or can maybe not have a jet velocity and settle down in and around people and sources of ignition. And a number of companies have made changes and removed blow-down drums and stacks, including BP that removed all their blow-down drums from their refinery in Texas City. So, I think as a scorecard, there have been improvements but there's a lot of work to be done.

24.1.53 DANIEL HOROWITZ

Why don't we leave it there, Mr. Chairman. And there are more questions we can perhaps handle later.

24.1.54 RAFAEL MOURE-ERASO

All right. I think we need to take a 10-minute break and we will reconvene.

25 Day Two - Regulatory, Stakeholder and Public Interest Groups

25.1 Introduction of Panelists - RAFAEL MOURE-ERASO

Thank you for coming back. We are ready to begin. I am ready to introduce a series of distinguished panelists who represent regulatory agencies, stakeholder groups and public interest groups both from the US and from various countries around the world; these people whose careers have focused on the use of safety indicators in drilling, in offshore environment as well as issues concerning protection of the offshore environment.

Joining us today are Mr. Ken Arnold, which is the Chairman of the Committee on the Effectiveness of Safety and Environmental Management Systems, SEMS, for Outer Continental Shell Oil and Gas Operations. Also, Mr. Ian Whewell, Former Director of the HSE Offshore Division of the United Kingdom. Mr. Jake Molloy, Original Organizer of Offshore Energy Branch from RMT O.I.L.C., also from the United Kingdom. Mr. Roy Erling Furre, Second Deputy Leader from SAFE, which is the organization that takes care of safety issues in Norway. And Øyvind Lauridsen, Principal Engineer from the Petroleum Safety Authority (PSA) of Norway.

In addition, we also have Miss Lois Epstein, a professional engineer at the Arctic Program, Director for the Wilderness Society. So, I would like to start the panel with the remarks of Mr. Arnold. Mr. Arnold, please.

26 KEN ARNOLD – Lessons from the National Academies Report: Evaluating the Effectiveness of Offshore Safety and Environmental Management Systems

Thank you, Mr. Chairman, and thank you for inviting me here. I'm a little bit of a fish out of water since I'm not a regulator. I work for a company called Worley Parsons, which is an engineering company. But you were so kind as to invite me because back in 2009, the Minerals Management Service, which was the predecessor to BSEE or BSEE, the Bureau of Safety and Environmental Enforcement approached the Transportation Research Board of the National Academies to do a study on the status of their offshore inspection systems and what improvements needed to be made. After Macondo occurred, our charge was changed as a result of the Macondo incident and we were charged with coming up with a report – that's shown here on this slide – Evaluating the Effectiveness of Offshore Safety and Environmental Management Systems. And I'm going to use the abbreviation, SEMS, S-E-M-S, for Safety and Environmental Management Systems. And when I use that, I'm really only referring to offshore oil and gas and not to onshore or anything else.

Basically what SEMS is as a matter of background very quickly, any managerial activity, whatever you're going to manage requires elements of planning, organizing, implementing and evaluating. What SEMS is a listing and a description of about a dozen different elements that fit into those four categories, very, very similar to PSM, which is used onshore. So, SEMS is no different from that, other than it specifically addresses how you would apply a PSM to an offshore installation. The history of it was back in 1995, the MMS decided it was going to implement something equivalent to PSM and asked the industry to come up and work with it in helping to create something that would make sense offshore. The industry did that and issued API Recommended Practice 75, which was called SEMP, S-E-M-P, for Safety and Environmental Management Programs, rather than systems, but it's essentially the same thing.

The reason for the difference is offshore, we do have an active regulator who was quite knowledgeable in what we do. We heard a lot yesterday about the need for that for refineries and chemical plants, we have that in our offshore environment and that regulator mandated certain minimum standards, regulates equipment tests that have to be done and have to the documented and have to be reviewed; and, more importantly, it does regular inspections of our operations to make sure that we're meeting those minimum standards. So, we could incorporate that into our safety management systems as one element, one way of assuring that our safety management systems are taking place. There is another reason, and that has to be with our process, if you look at the production process, not the drilling systems but the production systems, which is mostly what we are concerned with, although lately the biggest accident was a drilling accident.

Before that, I will remind you the biggest accident was a production system accident, the Piper Alpha accident in the North Sea where a 167 people lost their lives. Our process systems are relatively simple compared to refineries and plants. We basically have to separate a natural gas, which flashes from a hydrocarbon liquid as the pressure is decreased. The natural gas is mostly methane, which is much less flammable and does not create bleves like some other natural, some other gases might do. And the rest of the process is mostly gravity settling of two immiscible fluids, oil and water, and trying to arrange that in some system. So, we don't have some of the more complicated chemical processes that you might run into in a chemical plant or an oil refinery. Another thing that makes it simple and makes a difference is we can shut down our systems in 60 seconds. And, as a matter of fact, we're mandated to do that. So, we have elaborate shutdown sensors and systems throughout the system, which are mandated to do just that, to

shut down. Okay, we can blow-down and remove all the pressure in a matter of minutes; and, even more importantly, we can restart to a stable operation in a matter of hours.

So, it's relatively easy to shutdown to a safe condition and restart again, which makes it easier to hit the ESD or the emergency shutdown button when you're on an offshore platform than you might do in a refinery where shutting down is a lengthy procedure and may require some risks associated with that because certain things have to be kept moving for a while you're cooling down and shutting down. A little bit about the history. In the mid-1990s, API 75 was accepted by API and the Offshore Operators Committee, and we were moving forward on the basis that it would be mandated by the Federal Regulator. But, along came something called the Contract with America that some of you may remember. A guy by the name of Newt Gingrich created that and a wave went through Washington that said, no, we're not going to regulate, we're going to make things voluntary. And, so, the government on its own, not the industry, the government decided to make SEMP RP 75 voluntary and not mandatory. Some of us were quite upset when the government decided to do that. In 2006, the MMS decided that it was going to make some of the elements SEMP mandatory but not all. It was a lengthy process, and, finally in 2009 – well before Macondo – they decided with industry's support that if they were going to do anything, they had to make it all mandatory and not just four of the elements mandatory, and industry supported that on a going forward basis.

Unfortunately, Macondo occurred in 2010, in April of 2010, and that actually delayed the rule-making process by several months. And, so, the mandatory SEMP SEMS system only came into effect in November of 2010. Absent Macondo, it would have been actually in effect sooner than November of 2010 as the regulatory process was well along at that point in time. With that as a background, let me talk to you about the committee that I chaired which has recently issued its report. Our report is available on the National Academy's website, you can download a copy for free. And the question that this committee asked was just to answer a basic question: *are there are objective KPIs that indicate that an elevated probability of a major event is in existence at a location.* We looked at this for a while and we decided as a committee that we could not identify a suite of KPIs, objective KPIs that could be implemented without further study and further understanding of how it fit everything. However, what we did and we reached the same conclusion everybody else has reached and you have now reached, that the list of the KPIs we were using are ineffective for process safety. But we took a slightly different approach and I'd like to bring you through that different approach which is slightly different than what we've been hearing about for the last day and a half. And that approach is about there seems to be an agreement that one way to reduce the risk of a major accident to have an appropriate culture of safety.

This has been repeated in both the President's Commission report on the incident and in the National Academy's report. Both of them talk about the need for a better culture of safety as being a primary concern. Unfortunately, neither one of those reports describes what they mean by it or how one accomplishes it. So, we took the task that we don't have time right now to come up with KPIs – although they should be done, we're not against them. As a matter of fact, in our report, we actually recommend and there is some wording in the report and it's in my statement that I've given you the wording out of our report that recommends that work be done on finding KPIs. But we don't have to wait for that. If we accept that culture of safety is important, then the question then becomes how can we develop a performance indication that an appropriate level of culture of safety actually exists in a specific operation. So, we're twisting it around a little bit, rather than looking for a particular KPI, we're saying how do we measure culture of safety. So, let's talk about defining a culture of safety.

A culture is a set of shared values and beliefs that interact with an organization's structures and control systems to produce behavioral norms (there are various definitions in the literature, this is one). And if you take that, then a culture of safety, to our way of thinking, is a culture in which critical decisions are made in such a way as to reduce the risk that competing goals and inadequate knowledge compromise safety. We will always be in a position where we have competing goals, time, money, safety, environment. Many goals will be competing. We cannot do away with that but we need to make sure that we have to reduce the risk that decisions are made in such a way as to be acceptable given these competing goals. To do that in our report we say there are things that need to be done from an organizational perspective. From the perspective of the organization, there are mechanisms that need to be in place that establish the structure and control that specify what is needed to operate safely and check that it is actually being done. But, importantly, there are also have to be actions. And these actions are the actions that establish the safety norms; these are actions at every level of the organization, not just the CEO, though we keep talking about that. But it starts at the CEO but every level of supervision down to the lowest level of supervision needs to take actions that establish the safety norms that encourage people to take risks for safety. Even when no one is looking, when it is not in their immediate best interest, when they are under stress or when they face inadequate, insufficient and uncertain information.

More than that, from an individual's perspective, there must also be mechanisms that establish competency; that is the technical knowledge of operations and as well as the knowledge of the structure, control and behavioral norms that exist within the organization. From an action standpoint, from an individual's standpoint, again, the individual has to be taking actions that show that he's motivated to act in accordance with these behavioral norms when under stress and in dynamically evolving conditions. Everybody can act correctly when given all the time in the world to make decisions but that's not where safety exists, safety always exists in some manner of stress, some manner of making decisions on the spur of the moment. Okay, so, how does SEMS relate to safety culture?

A properly function SEMS addressing- addresses the mechanism element necessary to create a culture of safety, it has mechanisms for the organization, the structure and system of controls the concepts that I've talked about before of planning, organizing, implementing and evaluating how the system is working. And from an individual's standpoint, the mechanisms of training and competency are also required by SEMS. But SEMS does not address the action elements; it doesn't say that the actions are there that establish behavioral norms. It puts a structure for it but it doesn't establish it. From an individual, it doesn't establish that the individuals are actually competent and motivated the way we want it. So, therefore, SEMS is a necessary but not a sufficient element in creating a culture of safety. So, now I'm going to restate the problem one more time. We've said that as a performance indicator for major accidents, I need to have a good culture of safety. SEMS is part of the way there, so I'm going to restate it as saying how can we evaluate the effectiveness of a specific SEMS program in such a way as to measure both the mechanisms and the action aspects of a culture of safety.

Well, one thing is evaluating compliance. We can evaluate SEMS compliance with some kind of a pass/fail system, are the policies there, do they exist on paper, do they cover all the required elements, do they cover the elements in sufficient detail. That's the mechanism aspects. But reliance on compliance ignores the action aspects – norms, motivation, behavior that determine whether the mechanisms aspects are actually used in brackets. Therefore, the compliance alone with a pass/fail system with some kind of metric that just says do you have this or do you not have this cannot by itself evaluate the degree with which a specific operation as an adequate culture of safety. It is partially the answer but not the whole answer. So, how do we evaluate the action aspects? It requires understanding or recognizing whether

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SEMS is understood by all within the organization – that means everyone, all is everyone. Is SEMS utilized as designed, are people actually doing what they're supposed to be doing, and do the norms and motivations of a safety culture actually exist in everyday practice?

This requires time, onsite observations, and, unfortunately, something we engineers abhor, subjective judgment. Okay, a team of qualified evaluators who are familiar both with the technology involved and the operating environment of the company is necessary to make this evaluation on any one specific installation and they have to take the time to interview the staff at all levels in order to be able to do that. And something I'd like to add is an evaluation in implementation of numerous and complex human actions over time, the implementation is never perfect. Any good quality evaluation of the safety culture or of SEMS and how it's actually working is going to find deficiencies because over time, things change; and an evaluation which does not find something which can be improved concerning the action aspects is probably not a good evaluation. The net result of that is you can't measure it by a pass-fail system or by a simple metric.

What you really need is some kind of grading system. It shows where you are on the specific elements of SEMS and where you've been and where you're heading and how you can improve it. And it requires feedback all the way through top management that says okay, we've looked at it, here is what we found, here's areas you can improve and here's way to improve them. So, we, if you read our report, you'll find it's really based on giving advice to BSEE. And we've given them this advice that they need a holistic approach to evaluating the safety culture of an installation, rather than fall back on their penalty, pass/fail, potential incident of noncompliance mode of operation. We're saying you can still do that, you need inspections for compliance to regulations and to make sure that the mechanisms of SEMS are in place. Okay but you also should require internal audits; and we go to great lengths of explaining why we think it should be internal audits and not third party audits. I don't have time to explain that to you now but I will if anybody asks me the question. But read the report; we go to great lengths explaining why internal, independent audits are so superior to external third party audits for trying to create the behaviors we're looking for. And the grading system should be somewhat – I'll let you read what's there in the interest of time. We also recommended they establish a whistleblower program, which they're in the process of doing in any case. What we found is that most incidents of bad behavior tend to be found out through whistleblowers. It's quite interesting some of the data that we've seen.

We think that BSEE should gather, analyze and disseminate learnings across operators based on their own inspections, based on the audit reports they receive, which they should evaluate, and based on their own audits. They have to have the ability to do audits themselves based on risk, not based on some time constraint as is currently in the SEMS program. We also made a pitch that they coordinate the international search for a suite of KPIs, coordinate with the international bodies for a suite of KPIs that may be possible to incorporate to provide some early warning indicators of safety culture, so, the conclusions very quickly. The committee itself did not find or recommend a specific set of performance indicators for major accident prevention. As a matter of fact, I think that we're seeing trying to focus solely on that is probably going in the wrong direction. The committee recommended a holistic approach to evaluating and improving the level of safety culture, which exists offshore in our installations.

Taken as a whole by coming up with a subjective evaluation of safety culture, that may in itself be considered a performance indicator for major accident prevention. Thank you very much.

RAFAEL MOURE-ERASO – Introduction of Panelist

Thank you very much, Mr. Arnold. That's a very thoughtful piece. Our next panelist, Mr. Ian Whewell. He is the former director of HSE Offshore Division of the United Kingdom. Mr. Whewell.

27 IAN WHEWELL – Performance Indicators in Major Hazard Industries – An Offshore Regulator's Perspective

Thank you, Mr. Chairman. Board members and CSB staff, thank you for this opportunity to share with you my views on this very important issue. There is a background paper, so I'll just try and cover the main issues in this presentation. Arrangements for measuring and monitoring health and safety performance must always form part of every company's management system. Regulators of the offshore oil and gas industry will therefore reasonably expect companies to have a comprehensive and effective set of indicators derived from such measuring and monitoring. These indicators should provide the critical information necessary to give the management of each company the confidence that their installations have been safety operated.

Indeed, I believe every CEO must be able to confidently answer two questions. First, are the risks on each installation properly controlled and managed; and, second, how do you know. Unfortunately, as we've heard the reality is that for many years, the basis for answering these two vital questions has often been flawed. Too frequently, the data used has not included sufficient detailed information on the control of risks, which can lead to catastrophic major accidents such as Piper Alpha and Deepwater Horizon. Many companies have measured all health and safety performance using occupational injury data alone. Let me be clear. There's no silver bullet, which will ensure that catastrophic accidents do not occur in the offshore industry. However, I am convinced that properly selected performance indicators whose data outputs are effectively monitored and which inform decision-making will make a significant contribution to reducing the risks of such an event occurring.

As we heard yesterday, there is still much soul-searching and argument when indicators are to be selected as to whether they are leading or lagging. I think this can often divert attention from their potential impact on performance. The important issue is that indicators used provide a clear view of the performance of the key major hazard control systems. Even so, if the use of performance indicators, however well selected and appropriate, is going to deliver the effective management of major accident risks, it is essential that offshore industry leaders of board and senior management level utilize these indicators; and that the data derived from their use informs decision-making at all levels in the company.

In identifying risks to be monitored and managed by the use of performance indicators, as I've implied, there is an essential need to differentiate between occupational risks and major hazard risks. I would not suggest that leading or lagging indicators should not be used to manage occupational risks as the control of these risks is a key responsibility of any employer; however, again, as we've heard, attempts to control occupational risks, even by using the most comprehensive occupational safety performance indicators will not deliver effective control of major hazard risks. Indeed, there's a probability clearly demonstrated by events that companies focused only on occupational safety and personal injury can become complacent in the face of good personal injury performance and cease to drive for improvements which will impact on major accident risks.

The selection and use of performance indicators, therefore, to manage major accident risks requires a different approach and must be based on each company's own processes and systems and on major accident risks and controls in that company. It is critical that there is within the company a very clear understanding of the risks to be managed. Without this understanding, there is a likelihood that the performance indicators used will at best be less effective, and at worst, completely irrelevant. To achieve

the active commitment of those in key positions within any company, the indicators used must be credible and clearly related to the management systems within the company.

Off-the-shelf indicators, therefore will often fail to carry the necessary recognition and relationship to company processes and procedures. If a company is to have effective and relevant performance indicators, it is essential that its managers have the knowledge and understanding of risk and know how to use both. Only with knowledge of the process hazards and risks and effective meaningful management intelligence in the form of appropriate metrics or performance indicators can management at the most senior level have confidence that major hazard risks are being adequately controlled. Measuring performance also relies on standards of performance being fit for purpose. Ironically, modern high hazard companies have developed highly sophisticated systems for dealing with plant and equipment not functioning as designed or with excursions from the steady state.

From day one, the plant and equipment is not as designed. This is reality and it is the reality that must be managed. However, this reality must not be confused with the acceptance that these exceptions do not matter. Indeed, deviations from design intentions can provide very real indicators of the health-health of the process plant and of the management systems. Thus, in deciding what to measure, key barriers or risk controls – as we heard yesterday from Ian Travers – must be recognized and such defects identified and recorded. Performance standards and variations from these standards can provide key indicators which can be used by senior management to take the temperature of safety performance.

Failures or the lagging indicators while they will not always paint the full picture of performance, also have their place and should not be ignored. Of course whatever is managed- whatever is measured should be kept as simple as possible to ensure clarity and must measure what is actually happening, not what the management believes should be happening. There is, however, no single indicator which is individually predictive of a major hazard event occurring. Major hazard events are invariably the result of multiple failures of control and in any one event, the critical failure path is complex and will differ from the next event. Whatever decisions are made on the selection of performance standards and indicators, the workforce must clearly understand what is important; and the best way of achieving this is to ensure that what is important is measured.

If performance indicators are to be used effectively to manage major accident risks, then how data are managed and used is critical. Unless at board and senior management level there is a recognition and an understanding of the significance of the data and the data drives decision-making, then its collection becomes an ineffectual exercise and leads to cynicism at plant level. Data from effective performance indicators must be used as a vehicle to drive improvement, and the role of the Board and senior management is vital in achieving this. There is an expectation by the UK Offshore Regulator, the HSE, that all oil industry leaders must know that their company measures major hazard performance using meaningful and effective indicators. They should be able to demonstrate that they understand the role of major hazard risk controls and the significance of key performance indicators. In addition, to achieve a convincing safety culture at all levels in the organization, industry leaders must acknowledge their responsibility for the effective management of major accident hazard risks. There must also be a recognition that the culture of the organization is important in ensuring that Board-level data is accurate and reflects reality, again, not what the Board or senior management would like reality to be.

The involvement of the workforce in developing and delivering effective performance indicators and the systems to support them must not be underestimated. A poor culture of involvement and failure to

secure commitment will result in data which are at best incomplete and at worst irrelevant to managing those risks. I have emphasized the importance of having suitable and sufficient performance indicators to enable offshore oil company boards and management teams to monitor major accident risk controls and performance. I have also emphasized the critical importance of the board and senior management commitment to the proper selection and use of data and to ensure- and to ensure a meaningful and accurate data collection and recording. However, I believe that unless and until the worldwide offshore industry starts to use these data to improve comparative performance and learn from the best performance, it will not be maximizing the benefit. This challenge should not be underestimated. Cross-industry sharing of data with the benefits that brings is beginning to take place in some parts of the world.

It is unfortunate that the US offshore industry still appears to continue to operate with little cross-industry sharing and to apparently lack the will to commit itself as a whole to delivering the type of common commitment seen for example in Norway and on the UK Continental Shelf. Whilst performance indicators and performance standards do need to be developed on a company and process-specific basis, the selection of a few key indicator agreed to cross the territory specific continental shelf can deliver real improvements and performance. Meeting the challenge of sharing the data and then benchmarking against the best performers is a real driver for change and improvement- improve of performance. On the UKCS, identifying the use of performance standards and indicators has always been a key aspect of the regulator's intervention approach. In recent years, however, following Texas City and an HSE report on installation integrity, the UK industry- industry's approach to performance indicators has come under a particularly fierce spotlight. HSE inspectors have focused on the way companies were using performance data, and in particular how that data was being used by management at Board and senior levels.

Top managers were expected to be able to describe their methods of monitoring performance, and boards were expected to be seeing major hazard performance data, not just accident and ill health data. HSE also began to work with the industry to see if it would be possible to develop some simple high-level performance indicators to be used across industry for benchmarking performance. Detailed data on hydrocarbon releases, as we've already heard, were already being collected on a common basis following a recommendation from the Cullen Report on the Piper Alpha disaster. This was a statutory reporting requirement. But as you'll hear later this morning, in addition to this, the UK offshore industry agreed voluntarily to adopt two key performance indicators, two additional key performance indicators. These were backlogged in hours per installation of safety critical maintenance and findings- and secondly, findings from the statutory independent verification of safety-critical plant and equipment. And the period- the length of time since those findings have been resolved that was still outstanding.

Collection of these data has been going on since 2008 with the greater part of the UK offshore industry taking part by 2009, allowing trends to be identified, and most importantly, benchmarking of company performance. In a revolutionary development, companies on the UKCS also agreed to share their performance data with each other and to share good and best practice, both in dealing with these common KPIs but also in developing company-specific performance indicators. This work was also supported by a series of key training sessions to help senior managers gain a better understanding of major accident hazard risks and the use of performance indicators. Interestingly, it was found that many lacked background on process and production, meaning that their experience of the major accident hazard risks was limited. The effect of this cross-industry approach to data collection has been significant. Not only can individual companies benchmark their own performance against the industry norms, but the poorest performers, highlighted by the sharing of data, have been able to learn from those with improved

performance. And, in addition, the regulator has been using the raised awareness of major hazard KPIs to press for improvements in individual companies.

In particular, by inspection and enforcement, the regulator can monitor the way the company- the way the output data from major hazard KPIs are being used by management at the most senior levels in individual companies. Where data are recorded using common criteria as with the agreed industry KPIs, individual company performance can be compared to an industry norm by regulators at intervention visits and performance challenged. It is particularly beneficial to us in the UK that the flexible goal-setting approach of the UK regulatory regime does facilitate the type of dialogue essential to achieve such outcomes.

In conclusion, my view is that all regulators of the worldwide offshore oil and gas industry must ensure that there are many performance indicators in place and that those indicators are being effectively used to manage and control major accident hazard risks. This must be a critical part of regulatory oversight. Thank you for your attention.

27.1 RAFAEL MOURE-ERASO

Thank you very much. Mr. Whewell. The next person I would like to welcome is Jake Molloy, he's (INAUDIBLE) union member, he belongs to the RMT Union, Original Organizer, Mr. Molloy.

28 JAKE MOLLOY – Safety Performance Indicators – An Offshore Regulator's Perspective

Thank you to the Board and the CSB staff for the great honor of inviting us here today. My paper is on your website. This will be an abbreviated version and it has as we're concerned at least, the workforce perspective of KPIs. For our members employed in the offshore oil and gas sector, it is vital that truly effective indicators exist which assist in the prevention of major accidents. Having an effective system in place is vital because failing to assess performance against some form of standard will inevitably leave the risk-takers, i.e., the workforce, exposed to the potential of serious injury and death. RMT therefore fully supports the use of meaningful and effective indicators. However, I would emphasize the word "effective" because all too often, we find that actual effectiveness of well-intentioned schemes can be rapidly diminished as managers seek to influence outcomes and meet targets.

In this statement, I hope to provide an insight into the effectiveness of some indicator initiatives used in our sector and provide our opinion on the underlying reasons for their success. I will also reflect on the ineffective use of indicators and highlight why these schemes are not only ineffective but are dangerous. It is our firm belief that the most influential and effective schemes using indicators to measure improvements and major accident prevention are those initiatives generated by our regulator, the Health and Safety Executive. Since 2000, our regulator has launched four key programs, each of which was generated as a consequence of poor performance in specific areas. I will look briefly at these in order to illustrate the positive effect.

Key program one was reducing offshore hydrocarbon releases. This doesn't require any in-depth explanation. There were simply too many hydrocarbon leaks occurring at the time and HSE wanted to address this and reduce the number of events. KP1 was launched in 2001 and placed the onus firmly on industry to get its house in order. The leak reduction initiative had a positive effect and the number of leaks occurring reduced significantly during the following years and still is. This is verified by the HSE annual Offshore Statistics reports which provide details of injury rates, fatalities and hydrocarbon leaks and are available on the HSE website. In those early days, however, industry was extremely sensitive about the kind of data being in the public domain and HSE was compelled to ensure the anonymity of the operators who were having these leaks. As the industry has embraced this initiative, the sensitivity has reduced, and slowly but surely, the industry has become more open and transparent. Indeed, since KP1 was launched, the industry has been proactive in setting its own targets for leak reduction; the current one being a 50 percent reduction in leaks between 2010 and 2013. And it appears, as I speak, that they should meet that target. KP1 was without question, the catalyst for the significant improvements achieved in reducing the number of leaks. In our opinion, there were several factors which have underpinned the success of KP1, not least of which was the regulator initiated the call for improvement, which was seen as a significant and substantive criticism of the industry's performance.

KP1 was launched publicly, meaning workers and moreover the press had the ability to report and monitor performance. In short, it was transparent and subject to public and governmental scrutiny. It was our opinion that all of these elements came together to create a significant deterrent to bad practice and drive improvement. HSE's KP II was drilling and deck operations. This program was initiated in response to unacceptable accident statistics from deck and drilling operations in our sector, statistics which showed six fatalities over a two-year period. The program was launched in 2003; and, once again, as it was being driven by the HSE's offshore division, it was out there in the public domain. Not only that, the fatalities

that had occurred at the time were mostly preventable, and so the inevitable prosecutions occurred and the industry was once again in the spotlight.

Court proceedings took place. Significant fines were levied against offenders, fatal accident inquiries held in public, all of which attracted widespread press reporting and public outcry. Again, the industry was being publicly criticized by the regulator and was being told to get its house in order. Again, we find the use of a lagging indicator and one, which is completely unpalatable – and it's the counting of bodies. However, the effect the initiative had is there to be seen. There has not been a death in drilling or deck operations in the UK since 2004. KP3 was asset integrity. In 2004, the HSE launched KP III, which was an HSE resource-intensive initiative involving nearly 100 coordinated, targeted inspections over three years. Its objective was to ensure that offshore duty-holders adequately maintained safety-critical elements of their installations. And you'll hear a great deal more about that this afternoon.

In November of 2007, the HSE published their findings in a report, which was seen as a comprehensive appraisal of asset integrity management on offshore installations in the UK sector. The report revealed significant issues regarding the maintenance of safety critical systems used in major accident hazard control in the industry. Once again, we had a publicly announced report by the regulatory authorities, which was extremely critical of industry and demanded significant improvements. Indeed, the report was so critical that in 2008, the UK government called on the HSE to conduct a review of the progress made to date against the 2007 findings. The HSE commenced their review that year and delivered their findings in late 2009. There had been significant improvement.

Key program four is the aging and life extension inspection program, which was launched in 2010. This initiative will run through until 2013 when HSE will report the findings. Once again, the regulator is driving the agenda and highlighting the concern they have which the industry is expected to address. I anticipate a quite mixed bag when we get that report. Supplementing HSE's push for improvements in these areas, the industry body, Step Change in Safety, has in recent years identified three key performance indicators as I alluded to by (INAUDIBLE). And they each of them benchmark against each other. These KPIs deal with the potential for major hazard events as opposed to occupational risk and behavioral issues which tended to be the focus of the group for some time. This KPI initiative is having a positive effect but we would suggest the greater willingness of the operators to accept that transparency and sharing of experience has had the greatest effect. Before turning to the ineffectiveness of indicators, I would like to briefly highlight what our union was doing during the period that HSE launched these programs.

Prior to KP1, during 1999 and 2000, our union had staged some high profile press briefings about the number of gas leaks occurring and why. We demonstrated there are widespread failures on the part of industry and that luck, rather than good management, had prevented some leaks escalating into major events. Prior to KP II, our union had campaigned for greater mechanization in the drilling sector and greater focus on competence and training of workers. We had supported the family of one worker by providing legal representation at a fatal accident inquiry. Their son had been killed after he was dragged – excuse me – after he was dragged into a 10-inch hole in the deck while attached to a harness and suspended on the end of a 5-ton lifting winch.

Prior to KP III during 2003/04, our union made several complaints to the HSE about maintenance backlogs, the use of temporary repairs on gas lines, and our concerns about safety-critical elements on certain installations. One such complaint about a specific operator was investigated over a three-month period, culminating in the HSE writing to tell us that in their opinion there was no imminent risk to personnel on that operator's installations. Just 21 days later, two workers died on that operator's

installations. They were asphyxiated after a series of safety-critical elements and several tons of gas escaped into a confined space through a temporary repair. It was subsequently found there were thousands of hours of backlogged maintenance.

And, prior to KP IV, our union has been highlighting the appalling condition of some installations by using freedom of information requests and accessing reports produced by the HSE, then publicizing these in our union magazines. So, ineffective indicators, just before turning to the process safety aspects of the dangerous part – as I call it – I'm compelled to comment briefly on the collation of statistical data by industry and the regulator. And, specifically, I have to say a few words about the recording of lost time injuries. This figure is ridiculed and dismissed by most of the offshore workforce because of the way it is easily manipulated and distorted. Light duties, offshore or onshore, avoid a report. If the worker is a service hand or an agency hand, they aren't included in the figures. Workers regularly don't report for fear of disciplinary action against them or their colleagues. Bonus schemes and incentives deter reporting of incidents and injuries, and there is a fear of being involved and/or reporting an incident, which could career development.

In short, we would argue that LTIs are not an indicator which should be used as evidence of improvement or otherwise. Turning to the dangerous aspects of setting key performance indicators, I've opted to use the testimony of an existing production supervisor on an oil and gas installation in the North Sea today. I asked him what his understanding was of the use and application of key performance indicators and this was his response. I quote. The system of setting, measuring and stipulating what KPIs are was agreed between the client and the service company's senior management. The financial enhancement to the company if all KPIs are achieved was in the region of 6 million pounds per annum. How the service company then shared this was up to them. In our case, the maximum bonus achievable for the 70 staff at technician level was 3,000 pounds, although this has now been increased to 15,000 pounds.

The KPIs were split into five categories: Maintenance backlog, gas injection, water injection, oil production, and safety. These in turn reduced the specific KPIs. Safety is divided into the number of lost time injuries, the number of stop cards submitted, which was communicated to the troops as STOP participation with the reassurance that it was not a numbers game, when in fact it was. And, finally, any reportable safety or environmental incidents or HSE enforcement also counted against achieving the full amount.

Oil production is a very subjective target where the reservoir engineers speculated on the potential production in ideal conditions, and this figure how to be agreed by the service company production engineer onshore. Any production figures below target then becomes a process of apportioning blame so as to ensure the losses do not go against the service company. This also serves as a stick with which to beat the entire operations department and more so the control room operator.

Water injection for some reason as a high proportion of overall bonus, despite the fragmented nature of the reservoir. Uptime on a single machine is so critical that even a few failed stops would not stop efforts to get it running again. The consequences can be alarming with the exhaust bellows going on fire due to too many failed starts on diesel, leading to unburned fuel getting through the exhaust, which has subsequently caught fire.

The safety KPI then leads to the non-reporting of the fires, until I intervened and insisted the one I witnessed was reported. Gas injection is again a sensitive subject on the basis that the client has specified a

capability requirement of the facilities on the vessel, which cannot be achieved. Yet we had secured the contract by insisting we could meet the targets, so any shortcomings have to be minimized and keeping the plant running is vital. Maintenance backlog is another double-edged sword in so far as it only possible to do certain maintenance when machinery is down. Factor this in and should be fine, but if there is further downtime on those pieces of equipment which you have already put down to maintenance, then you either try to condense the actual time- downtime for maintenance, or do less maintenance.

The KPIs looked at the number of hours of backlog on planned maintenance routines. The high level intent is easy to sell; KPIs should be SMART, this is Specific, Measurable, Achievable, Realistic and Timely. They are intended to encourage efficiency and focus on the five key aspects listed. This, then, is the corporate stance but as this descends down the ladder, the field management then use this as a psychological tool to try and squeeze as much work out of their subordinates as they can. If, however, there is an occasion where things are not possible, then a different approach to reporting performance is required to ensure the records – to ensure the records show things have been done as per the KPI.

In reality, the bonus scheme and KPI system is sold to the troops as a potential to earn money, but one which can quickly be reduced to zero if operations aren't properly controlled. KPIs create a divisive environment where shortcuts and non-reporting are commonplace but not spoken about. And I'll leave his testimony there as I just realized I'm against time. I'll conclude by saying I hope this testimony of this member shows is that KPIs linked to incentives can very quickly lead to a situation where senior management believe that safety and productivity performance is good, when in fact, the opposite is the case. This is not a unique case; there are others that operate in a similar way; however, neither is it indicative of how operations are conducted in the North Sea. In fact, I would say this case is firmly in the minority. Nevertheless, the testimony demonstrates it can happen and is still happening, with the outcome being production and maintenance reports are distorted or even falsified, there could be widespread underreporting or even non-reporting, and this quickly becomes institutionalized.

Workers quickly draw the conclusion that the entire safety agenda is little more than a sham and workers who refuse to fall into line are intimidated and bullied and end up quitting rather than be seen weak. In summary then, there is a place for indicators in this industry and they can have a very positive impact on the prevention of major accidents. However, to be truly effective, we would argue there must be an independent aspect to the introduction of the scheme and the auditing of it. Moreover, we would advocate that the regulator should be proactive in the setting of goals and the monitoring of performance. At a worksite level, if indicators are to be used, we suggest that bonus schemes and incentives of any sort should be avoided. The independent verification system currently applying in the UK safety regime measures an installation's performance against a set of predetermined performance standards for safety critical elements and maintenance their reports could be used to assess how an installation was performing.

The submitting of STOP cards or any other similar observation system must not be used as an indicator, nor should LTI. When workers see these systems being abused, it detrimentally affects the attitudes of workers. That quickly takes me to my conclusion about something that's being launched this year (INAUDIBLE). It's a tool which will be launched by Step Change in Safety for measuring the levels of workforce involvement by way of a question set. This aspect is most crucial as without workforce buy-in and the delivery of honest responses, the survey tool will not provide a true assessment of what might be described as the safety culture. For years, we've toiled with the idea of measuring something we can't see. Hydrocarbon leaks can be measured, verification schemes can be assessed and so on, but measuring how a workforce feels about their participation and the safety agenda has never been assessed in any

meaningful way. This new initiative has the potential to be Step Change in Safety's fourth KPI, closing the circle, as it were, by linking the crucial inputs of workers into the mix of major accident prevention indicators.

As a trade union representing workers in this high hazard industry, we see this as vital because, lets' face it, we can have the most technologically advanced systems on the planet coupled with indicators which suggest safety and productivity performance is meeting and beating expectations. But if the people operating these systems and delivering these results are unable for any reason to tell you what the true picture is, everything becomes worthless. Thank you.

28.1 RAFAEL MOURE-ERASO – Introduction of Panelist

Thank you, Mr. Molloy. Our next speaker is Mr. Roy Erling Furre, Second Deputy Leader of SAFE from Norway. Mr. Furre.

29 ROY FURRE – Safety Performance Indicators as an Effective Way to Prevent Accidents

Thank you very much. First of all, on behalf of SAFE, I will give my regards to the Chemical Board for this invitation. I am the second deputy leader of the Norwegian Union, SAFE. That is organized personnel working in the Norwegian oil and energy sector, onshore and offshore. We were established in 1977. The union organizes 11,000 workers in the Norwegian oil industry. The key points in my presentation that can be seen on the screen is about these things. It's establishing and use of tripartite arenas; establish working environment committees and safety delegate system based on the union and collective systems; address the importance of job safety and unions; secure a good quality of the indicators; avoid use of individual incentives towards outcome of indicators or weighting of the Health and Safety reports; honesty and transparency around incentives and bonuses; and standardizing the reporting and weighting of incidents; and also issues regarding power and relations between employees, subcontractors and other stakeholders.

SAFE´s most important arena is to give our influence to collect and to use indicators in the Norwegian oil industry are through the risk level project, the RNNP and through the participation in Safety Forum, our most important tripartite arena, where all the parts is represented. It is necessary that all parts give their input to this work. Most of us occupied with safety in the oil industry are eager to increase the quality of the indicators we use. A major problem is that many external forces are influencing the quality. Banks, insurance companies, boards and governments ask for lost time injuries statistics and indicators, the LTA and LTI. Combined with behavior-based safety, where reward and punishment is used, the LTA numbers is highly underreported. Therefore the LTA, lost time accidents, is the most useless indicator we have. Sadly, it is also the most used indicator.

The Deepwater Horizon had seven years without any reported lost time accidents. This gave us no indication that a major accident would occur the same day as the prizes were to be handed out.
When an indicator is important to the reputation of a company, the human resource department, the HR, starts using personal bonuses and incentives in order to make the indicator look good. This will always lead to underreporting and manipulation of the indicator. A close involvement of the unions, tripartite arenas, safety delegates and workers is a good way to counteracting indicator manipulation. So would also a third party verification be. What if a parking guard would get a bonus if there were zero or few wrong parkings? He probably would not write as many parking fines as he should. The same could happen in an investigation where you should weigh the severity of an incident – red, green, yellow as some companies do. If someone in the investigation team can get or keep a personal bonus when the incident is reported as a minor incident, then the chance for manipulation will increase.

So, as a recommendation, we need to demand honesty and transparency around any payments or bonus to anyone involved in the reporting or evaluating the report and weighting of incidents and indicators. To get good indicators, we are always in need for new and better indicators and ways to improve the ones we have already got. We need to keep away the human resource department and their incentives in order to secure the quality of the indicators. And some good indicators to avoid major accidents could be: well control, well incidents, kicks and things concerning the well control.

And point two, the level of and the resources used on training and competence. Three, the working hours and fatigue management because the understanding of human limitations is important to avoid accidents. Four, working environment, the activities to avoid hearing damage, chemical exposure, and

ergonomics will tell us something about the quality of the health and safety activities in any company. Five, the level of union and workforce involvement together with transparency will be an indication of what quality we can expect of the indicators. Six, backlog of maintenance; that's always a reoccurring problem. Seven, make an indicator that is measuring the relevance between causes and measures of the accidents and incidents. The quality of investigations and the competence of the investigation team are important when it comes to good learning and improving based on the report. In Norway, we also have often seen that there is no connection between the causes and the actions, the causes of events, and the measures that is used afterwards.

We can see that inexpensive solutions such as rewriting of procedures are often chosen instead of improving the direct and underlying causes of the accident or the incident. If the causes are due to technical, a lack of planning, lack of competence, then these lacks is often not corrected. Therefore, as a recommendation, an indicator measuring the relevance between causes and measures could be useful in order to see if the causes are corrected, as they should be. Another thing that have been addressed in this conference is standardize the reporting and comparison of indicators. Most companies have their own ways to do the reporting and the weighting of the incidents. A new standard developed in a tripartite arena could be useful to do the reporting in the same way in all companies. This will make any comparison or analyzes easier.

And, now, I'd also like to address some issues regarding power and relations between employer, employees, subcontractors and other stakeholders. This is important, I believe. If the difference in strength is too big, it will make it very difficult to bring up health and safety issues. Who will dare to push the stop button when the big cost is involved? And that way, by giving the safety delegates more authority and the right to stop work, then it is possible to level out some of the differences in power. I would also like to point out the importance of job safety and the appearance of unions in order to stop dangerous work and bad conditions, it is important with good job safety. This will prevent a worker from being sacked if he or she intervenes with unsafe conditions. A good workforce involvement is always necessary to get involvement and information from those who are hands-on in the operations that are actually doing the job. In order to make it safer for a worker to be outspoken and involved, the health and safety involvement must be based on a safety delegate based in union representation. It is so much easier to speak out on behalf of the collective workforce than on behalf of yourself alone. The Norwegian Safety delegate system can only function because all the involved parts want it to and support the system. It is also based on a very good and strong working environment act, strong unions and the safety delegates the right to stop unsafe activities, no matter how expensive it could be. It is forbidden to retaliate against safety delegates.

I would also like to mention that we have examples on this right to stop work have been abused by safety delegates. The working environment committees are among the most important arenas inside the companies. They shall study any health and safety reports, accident reports, and can give advice and demands to the company's management in order to improve for health and safety work and, at last, where to anchor the good work and the good processes. The tripartite arenas between the organizations of the unions, companies and government are necessary to bring up and solve the challenges in the industry. And that's our last recommendation. The oil industry in all the countries should establish a central tripartite arena as the Norwegian Safety Forum, this in order to let all parties in the health and safety work come together to debate what measures and improvements that need to be addressed. In order to make this happen, we need a political demand. That is very necessary. I thank you very much for the attention.

29.1 RAFAEL MOURE-ERASO – Introduction of Panelist

Thank you very much, Mr. Furre. Our next speaker is Mr. Øyvind Lauridsen from the PSA, it's the Petroleum Safety Authority of Norway. Mr. Lauridsen, please.

30 ØYVIND LAURIDSEN – Trends in Risk Level Norwegian Petroleum Activity (RNNP)

Good morning. Hello. Thanks to CSB, Chairperson, Board and staff for inviting the Petroleum Safety Authority, PSA, to present our view and experience with the developing of and using safety indicators in our efforts to prevent major accidents. I will present the development and use of the Trends in Risk Level project in the Norwegian Petroleum Activity. The project is abbreviated RNNP. I shall only focus on the offshore part of the RNNP. We have the same for the onshore.

In the late 1990s there was a widespread disagreement between the parties in the offshore petroleum industry regarding the trends in risk level at the Norwegian Continental Shelf. Unions claimed that cuts in workforce and demands for simpler and faster project execution had resulted in an increase in the risk of serious accidents. The oil companies and their organization at the other hand claimed, mainly based on lost time injury statistics, that the safety never had been better.

We as a safety authority lacked a basis for knowing which way the risk trend actually moved, and we had insufficient info- grounds to prioritize our efforts and challenge the industry in the areas where they had to improve their performance. The Trend in Risk Level Project (RNNP) was initiated in 1999 to develop and utilize measuring tools which should illustrate the development in the risk level on the Norwegian Continental Shelf. Further, it should provide a basis for prioritizing of safety and work environment efforts in the industry and the prioritizing of PSA supervisory activities. The project is now converted to an annual activity, has been carried out 12 times and methods and indicators have been adjusted and improved every year. Still, main emphasis has been that trends should be possible to track back in time. It was important to establish a description of the risk level the parties in the industry could agree on was sufficiently reliable. Therefore, the methodology used in RNNP was, and still is, developed in close cooperation with the collaborating parties in the safety forum. Safety Forum is the central arena for cooperation among the parties in the industry and the authority as regard health safety environment in the Norwegian petroleum activities.

RNNP is managed by PSA, who is responsible for the project. The project is supported by highly qualified safety experts from national academic institutions, from the E&P companies and well-known experts within their respective fields. The companies' participation is essential for the collecting of data with good quality, and they participate in developing methods and indicators, useful both for the company's own safety management and for the industry as a whole through RNNP.

The tripartite cooperation in Safety Forum and the advisory group, a subcommittee for Safety Forum, create a sound arena for discussion of results and the development in the risk level. Thereby, agreement is developed on important aspects that have to be prioritized and addressed by the different parties. One could also argue that the tripartite cooperation give the indicators more authority. A key aspect of the RNNP approach is to identify relevant indicators reflecting different aspects of risk relevant for the petroleum industry. Safety performance indicators may be of very different kinds. We should also always have in mind, though, that an indicator is an indicator of something, not the phenomena itself. Both leading and lagging indicators are developed and used in RNNP.

Analysis is based on the triangulation principle – that is to use different methods, indicators and tools to measure the same phenomena. We can in principle split our indicator and tools into seven broad categories. We have major accident precursors. This is the central focus area in our work. Major accident

in this context is typical and an accident with the potential of generating multiple fatalities. I will come back to a few of these indicators later. Other accident indicators: Accidents with lesser potential; for instance, total loss of power, falling objects, serious occupational injuries and fatalities. This is mainly lagging indicators. Barrier and maintenance, these are leading indicators that provide us with information about robustness of barriers. The focus here is on barrier performance and relation to prevent or stop loss of containment. For instance, failure rates from test of safety wells is an indicator. The maintenance indicators focus on maintenance management; for instance, lag in risk classification of equipment and backlog in preventive maintenance for safety critical equipment.

We have since 2001 carried out a comprehensive questionnaire survey distributed to all employees on offshore petroleum installations, including contractors. The focus area for the questionnaire are safety climate, which comprise the employees' perception of different aspects of safety management, how safety are prioritized, and the empowerment of the organization to act adequate in relation to risk. In addition, the questionnaire covers working environment perceived risk and health issues.

The qualitative studies are based on social scientific principle. The purpose of these studies is to obtain more in-depth knowledge about certain challenging issues that had been identified from other indicators or measurements. For instance, based on a negative trend in well incidents in the period 2008 to 2010 in Norway and the Macondo blowout, we carried out a study on causes and measures related to well control incidents last year. The occupational illness and injury indicators, they are mostly leadings, are developed for chemical exposure, noise exposure, and physical working environments. And we have a new both leading and lagging indicators on acute spills to environment. This was established in 2001. In RNNP, we use the results and information from these tools and indicators to synthesize a conclusion related to the risk level.

: Indicators need data. I have already mentioned questionnaire data. Qualitative data comes from various sources, often interviews, fieldwork, or by analyzing and systemizing recent material. For instance, incident and investigation reports. The quantitative data is collected from two main sources: directly from the industry upon request, typically a letter with a spreadsheet once or twice a year; the other source is our own internal database containing information which the companies are obligated by regulatory requirements to send in. For instance, incident data, working hours, and daily reports on drilling and well activities. The dataset is then quality-assured by PSA and the company, at least when practical by swapping data in order to check each other's data. Process safety performance indicators should constitute observable- observable measures that provide relevant insight to improve process safety.

In RNNP, we have identified and used a set of indicators related to major accidents. Most of these indicators are well known and in use in the industry as requisite for risk management. In RNNP, we have together with the industry, identified common criteria for different defined situations of hazards. And for major accidents, we have 10 indicators. This figure shows the frequency of these major accident precursors in the period 1996 to 2011. It does not show the risk because the different situation of hazards covers a wide range of risk potential and because within each category, two incidents also can have very different risk potential. Even they are all (unwanted) incidents; and, in that manner, lagging, they are still leading for major accidents. Later on, I will give you an example on how these indicators are used to estimate the trend in risk and go more in details regarding the well incident precursors, shown as the green section of the columns of the slides.

The slides show mainly that the frequency fluctuates, but on average is 75 per year is sufficient for statistical analysis both within most of the different categories and in total. What are the characteristics of

an effective indicator? Based on the PSA experience, there are a few critical issues that are important in relation to developing indicators. The indicator must map the phenomena in question. The indicator must be sensitive to change in the measured phenomena. It means positive and negative change in the real world should be reflected in the indicator. The amount of data must suite the intended use, for instance, counting major accidents won't give any statistical foundation, counting precursors to major accidents could give enough data. The more intuitive the indicator is, the better, especially in relation to communication. The indicator should be meaningful and of importance for the companies in their own work for improving safety.

Major accidents are fortunately relatively rare, so lagging indicators based on the number of major accidents would provide insufficient information when it comes to prevention. Our work on leading indicators, to be precise, establishing precursors of major accidents has shown useful to map relevant and specific risk in order to direct measures towards them, and, hence, to prevent accidents from occurring. Since we are able to monitor the development in risk level from year-to-year, it also becomes possible to evaluate whether implemented improvement projects in the industry are yielding results and it enables both the PSA and industry actors to define what areas to focus next, so it helps us and the industry in prioritizing the most important risk areas. We find it absolutely necessary to use leading indicators when it comes to prevention of major accidents.

Different activity level measures are used to normalize both leading and lagging indicators. Examples of such normalization measures are the number of production installations, number of mobile drilling units, number of working hours, produced volumes, length of pipelines and number of exploration and production wells. The normalization measures used will depend on the nature of the indicator. The activity level measures make it possible to compare from year-to-year, across companies and different groups of companies and installation. As an example of one of the ten major accident precursors, I shall use the well control incident. The well control incident is a precursor, are leading indicators for the major accident, a blowout. With regards to this indicators, we have defined a set of criteria for reporting well control incidents from the companies to RNNP. These criteria are further developed in collaboration with the Norwegian Oil Industry Association, OLF, and the RNNP criteria are adopted by new OLF guidelines. And I'll use the categorization matrix from this guideline as an example of leading indicators for blowouts. The matrix shows the categories of well control incidents that could lead to a blowout; the categories are further detailed in the guidelines with examples. The matrix shows ten incident categories that are used as leading indicators for the major accident blowouts. The RNNP categories in the second column refer to the different probability for escalation into a blowout with loss of life based on empirical data. For instance, a regular well in control – well control incident (that's a category 1) has the probability of two per thousand to result in a blowout with loss of life, while a serious shallow gas (category 5) will be individually assessed but will typically have an empirical probability about 50 percent for resulting in loss of life.

These figures show the distribution of well incidents, including shallow gas, for exploration and production drilling. And this is normalized per 100 spudded wells, the actual years. Since 1996, we have registered nearly 300 well control incidents in total and the frequency of 18 per year, which fulfill the criteria for counting in the RNNP database. We observe that for exploration drilling, the number of incidents per drilled well fluctuates. On average, there seems to be around 15 incidents per year per 100 spudded wells. For both exploration and production drilling, we observed an increase in 2009 and 2010 and the industry (INAUDIBLE) by PSA in Safety Forum to improve efforts towards better well control. In 2011, the rate has decreased but it's too early to conclude whether the efforts are the main reason; we have to have more statistical (INAUDIBLE) for that.

As mentioned earlier, 10 of our indicators are related to major accidents. This figure shows the major accident risk for mobile drilling units for the period from 1998 to 2011. It's a weighted risk indicator with respect to potential loss of life; the frequency from each of those accident precursors are multiplied with respect to weight factors. This is summed up for all precursors for all mobile drilling units. For the mobile drilling units, we see that in the recent years, the major accident risk indicators has established itself at a lower level than in period before 2005.

The output from RNNP is a general report and a summary report on the industrial level. The results are presented for Safety Forum where areas for improvement are identified. The industrial actors are being challenged to identify measures and implement improvements. Example of former areas where the industry has been challenged are anchoring failures, collision between supply vessel and installation, hydrocarbon leaks and well control incidents. The RNNP yields also data on company and facility level which is used in dialogue with the companies in order to point out areas for improvement, but no results on identifiable company are published, but both PSA and the company know their own results. The RNNP also help to prioritize the PSA efforts, both when planning the supervisory activity and when it comes to specific priorities.

My conclusion. To establish a broad range of leading and lagging key performance indicators in the area of major accident and to maintain these indicators are demanding work. But, for the Norwegian petroleum industry, it has proven very useful in order to identify, monitor and improve safety. RNNP will continue also in the future and indicators are continually improved, based on tripartite corporation industrial experience and international research expertise. Thanks for your attention.

30.1 RAFAEL MOURE-ERASO – Introduction of Panelist

Thank you very much, Mr. Lauridsen. And, last but not least, we welcome Lois Epstein from the Wilderness Society. We really appreciate an environmental organization wanting to join us and talk to us today. So, Lois, please.

31 LOIS EPSTEIN – Safety Performance Indicators

Thank you, Mr. Chairman and the rest of the board and staff. Good afternoon and I appreciate your inviting me to speak today to provide a public interest perspective on the role of performance indicators in offshore process safety. Again, my name is Lois Epstein and I am professional engineer and the Arctic program director for the Wilderness Society. The Wilderness Society is a national public interest conservation organization, a nongovernmental organization for our international visitors founded in 1935 with over 500,000 current members and supporters.

My work focuses on ensuring the best possible performance for existing and future oil and gas operations in the Arctic, both onshore and offshore as well as elsewhere and protecting the Arctic's ecologically sensitive and subsistence use areas from new resource development. My background in oil and gas issues includes membership from 1995 to 2007 on the US Department of Transportation's Technical Hazardous Liquid Pipeline Safety Standards Committee. It's a federal advisory committee on pipelines which oversees oil pipeline regulatory and other agency activities, a current appointment to the Bureau of Safety and Environmental Enforcement's Ocean Energy Safety Committee. I also served as an advisor on the Interior Department's Report to the president on the BP Gulf spill that was issued in May 2010. I have testified before Congress on numerous occasions and I have analyzed in detail the environmental performance of Alaska's Cook Inlet oil and gas infrastructure.

I've worked on oil and gas environmental and safety issues for over 25 years for three private consultants and for national and regional conservation organizations in both Washington, DC, and Anchorage. My work on the BSEE Ocean Energy Safety Committee includes my participation on the Safety Management System Subcommittee, which is developing recommendations relevant to this Chemical Safety Board hearing. Our two recommendations to date focused respectively on safety culture and BSEE's Safety and Environmental Management System 2, or the SEMS II proposed rule.

As a technical person who has worked for environmental organizations for many years, my past work included developing normalized environmental performance indicators for a refining vehicle manufacturing and steel-making, which facilitated comparisons among companies and among states. These analyses were most valuable in identifying the top and bottom 25 percent of facilities using multiple normalized indicators for the groupings. Notably, this work used ongoing emission, rather than accident to measure performance. Both Exxon and Valero refinery staff are particularly supportive of this effort.

The areas I will discuss in detail today developed in part through discussions with Chemical Safety Board staff are listed above. First, effective industry performance indicator criteria. Two, improved data collection needs for offshore operations. Three, industry standards concerns; and, four, the federal government role.

From my perspective, key industry performance indicator characteristics include as shown above on the slide that they be applicable for an industry sector with few exceptions; multiple, independent indicators are preferred, they should encompass whole systems, i.e., not ignore contractors or components that are not part of a regulator's jurisdiction. They should include operator performance data from overseas operations as well as domestic. These characteristics have been mentioned by many during today and yesterday's presentations. The last characteristic is notable and I want to highlight that for one critical reason: overseas offshore operational data are a means to provide additional information about a company's safety culture. It is extremely frustrating for the public to learn about significant releases from

offshore overseas operations, whether these releases occur in the North Sea or Nigeria or elsewhere and to not have that information taken into account by regulators during permitting decisions, no matter how relevant that information may be.

I have actually spoken about this issue to BSEE staff and I've been raising the importance of gathering information from overseas and factoring that into their decision-making. And, more or less, I've been told that that's not part of the government's jurisdiction. On the topic of reporting, it's clear that one cannot measure performance without the necessary and good data. Currently, BSEE does not collect and utilize important process safety and lagging data, including data on all gas releases, cement performance, near-misses, etc. In my view, what's needed is a data collection overhaul by BSEE developed with process safety, improved data quality and public transparency as key criteria.

Historically, high quality incident data collection analysis has not been a priority for the former Mineral Management Service; in fact, the Department of the Interior has played the opposite role with former Interior Secretary Gail Norton redefining particular types of serious releases to justify the statements she made that there were essentially no hurricane-related spills associated with offshore oil and gas operations. On the needs listed in the slide, which by no means represent a comprehensive list, gas releases of all types, not just those with particular consequences are of interest to improve process safety. On oil releases, too often, there appears to be under-reporting in terms of volume. The volume of oil releases effects the penalties that can be levied under the Clean Water Act. As satellite monitoring of releases improves, certain reports of release size become untenable. Nevertheless, that's the information that the bureau has.

As for near-miss data, the Safety Management System Subcommittee of the Ocean Energy Safety Committee is looking at a recommendation to BSEE involving those data. Required reporting of near miss data supported by the National Commission on the Deepwater Horizon Oil Spill goes beyond what is contained in RP 754, as we heard yesterday.

Finally, the public interest community strongly supports making operator-specific data publicly available with shielding of company names kept to a minimum and only with a very strong justification. Sunshine improves the quality and increases the learning opportunities associated with accident prevention data. Potential litigation should not be a reason to withhold data, as litigation will occur regardless.

When industry standards are used in lieu of or in support of regulation, a variety of concerns arise. And I have summarized those concerns above. Some of these concerns were discussed at this meeting. In summary, these concerns are that the industry standards are developed by consensus, which can mean that they may be a lowest common denominator approach. Such standards may have elements that are unenforceable; for example, the word “should” - the word “should” and “may” may be used rather than “shall” and “must.” Such standards can contain gaps. Sometimes that is intentional, even though there are critical issues that may need to be addressed. The standards are often developed with little or no public or state regulator input and generally that's because of budget constraints, but there may be other reasons, that's true. And not all standards are publicly available for free, which is in contrast to regulations.

Lastly, the Chemical Safety Board requested feedback on the federal government's role in the collection and use of indicated data. In my view, the government needs to use the data collected for accident prevention as well as for inspection and enforcement targeting. The government needs to

determine industry-wide as well as operator trends; both are important. The government needs to use real-time data whenever possible to prevent accidents.

And, finally, I note that the collection used of government-specific performance indicators is important to ensure consistency in governmental activities amount regions, for example, and to ensure that governmental resources are dedicated where the needs are greatest. I thank you for this opportunity to speak and I look forward to the board's and the audience's questions.

32 Questions and Answers by CSB Board, Staff and Public

32.1 RAFAEL MOURE-ERASO

Thank you very much, Miss Epstein. I would like to thank the members of the panel. I especially would like to acknowledge the presence of the first stakeholders in the situations that I consider are the workforce in the place. And I would like to thank the United Steelworkers (INAUDIBLE) us yesterday, and today the National Union of Rail, Maritime and Transportation Workers of the UK and the SAFE Union for Norway. I appreciate your presence here. I apologize for how much we went awry in terms of time but I think that we could have a short period of questions and answers before lunch. I ask your indulgence in that. So, I will ask the board, Mr. Bresland, if you have any questions.

32.1.1 JOHN BRESLAND

Well, I – we have six presenters, so I'm not going to ask everyone a question. You're probably getting a little itchy here about getting out to lunch. But, I'd like to tie it together just with one question. Mr. Arnold's presentation and Mr. Whewell's presentation. I found it interesting that Mr. Arnold said that compared to the onshore operations like refineries or chemical plants, offshore operations are relatively technically straightforward. And then Mr. Whewell's comment that there needs to be identification of the major hazards risks. So, if you tie those two together, to me, it would seem that doesn't seem all that complicated to do, that -

32.1.2 KEN ARNOLD

It's not.

32.1.3 JOHN BRESLAND

The hazards are obvious.

32.1.4 KEN ARNOLD

Most offshore – now, keep in mind you have to look at two different things when you talk about offshore that I think are different. One is drilling and one is producing. So, let's focus just on the producing side because that's the background that the Chemical Safety Board is used to is process. When I'm talking about process, you know, chemical process type things, things chemical engineers know about. The processes that are used in the offshore industry are very simple and they're not very complex and they're repeatable. No two facilities look alike but they all have, if you will, unit operations that are very, very similar and very un-complex in terms of separation of immiscible fluids. We're not dealing with catalysts, we're not dealing with chemicals that were- you know that are creating chemical reactions. We're just dealing with basic separation processes. A little bit of pressure control, a little bit of temperature control and level control is 99 percent of what we do. And, we were able using this analysis to come up with the recommended practice in the 1970s, 14- API Recommended Practice 14C which uses that concept to do an analysis of the different pieces of equipment and come up with a scheme by which a designer or an operator or a regulator can determine the kinds of shutdown sensors and controls that would be needed as a minimum on an offshore facility. And that has been quite successful and have been – it's been used throughout the world. And it's really based on the simplicity of that process. Drilling is a different matter. In drilling, you're dealing with a dynamic situation with data that sometimes is not clear, you're remotely

sensing what's happening and trying to infer from that what's really happening. It's a very different kind of a situation than the process situation. So I don't want you to think I'm saying that drilling is not complex and difficult; it's just that from a process standpoint when you're talking about production, it's really a hell of a lot simpler than what you guys deal with on a daily basis.

32.1.5 IAN WHEWELL

Yeah, I'd agree with that comment that the process is simpler. And I think perhaps one of the difficulties with offshore is that there are hazards that don't exist onshore. You're in water, you've got environmental threats, storms and deterioration of – you live there, basically. And therefore I think when we talk about process safety indicators, it can – it can at times be a misnomer to all the major hazard risks offshore because there are a number of other risks and certainly dynamic positioning for drilling rigs can introduce additional risks, buoyancy – I could go on – which don't exist onshore. So, I think and that may be one of the reasons that process safety indicators have not been quite embraced in the same way because of the broad spread of the major hazard risks; in other words, the risk to destroy a whole installation such as P-36 in Brazil simply by sinking. So, I think that that will – the process is simpler but there are other major hazard risks.

32.1.6 KEN ARNOLD

I think the main difference that you have to always keep in mind is, as you're saying, you live on the platform and you can't run away from anything. If something happens, especially in a harsh environment like the North Sea, you have to deal with it with what you have on the platform. You can't call for the fire brigade to come in and help you out, you have to deal with it with what you have. In the Gulf of Mexico, it's a lot easier because in the final analysis, you can jump in the water and have a very high likelihood of surviving. That's not the case in the North Sea.

32.1.7 JOHN BRESLAND

Okay, I'll turn it over to Mr. Griffon. Thank you.

32.1.8 MARK GRIFFON

Thank you. Yeah, I will also probably focus not on everyone on the panel but Mr. Arnold I think the bulk of my questions are about this. I've had the opportunity to read most of your report and it's very interesting. I appreciate the mechanism versus action concept that you've laid out in the report very well with regard to safety culture because I think it's apparent. Many of us have looked at this, it's apparent that there is a delta, there is always a delta and you know so these audits and how these are done are very important. And I think going forward, I'm very interested in how this will be implemented. You know what, how will it be defined, what will be used to measure it and how do you audit it. So, all those things are important. I just wanted to ask is in the SEMS II – this may not be your question necessarily – because I've only looked at SEMS I, the first SEMS. In SEMS II, is it a proposed added element, safety culture, or-

32.1.9 KEN ARNOLD

Not specifically. And as a matter of fact, our report actually recommends that some of the items that are proposed in SEMS II are moving in the wrong direction from the standpoint of the regulator helping to work cooperatively with the industry to create behavioral changes as opposed to the regulator just punishing whatever goes wrong. We have a great belief in our committee that the statement that

beatings will continue until behavior changes doesn't really get you anywhere, that there are other ways to modify behavior.

32.1.10 MARK GRIFFON

The other thing you mentioned in your presentation was the whistleblower protections and I wonder – again, this is more a question for the BSEE folks but since you're here – is the proposed, in your opinion, is the proposal adequate whistleblower protection?

32.1.11 KEN ARNOLD

I'm not sure of the details of it that is in SEMS II. I think the devil is always in the details. It's the concept of whistleblower. But the one thing we said that's different is BSEE was looking at the whistleblower as someone who reports bad behavior on the part of the operator. And we said, no, the whistleblower is going to do that but you also have to have the whistleblower report bad behavior on the part of you as regulator and your staff.

32.1.12 MARK GRIFFON

That's good. And then this one. I think, well, I know we have someone from this organization later on one of our panels. But it was mentioned in your report – I don't know if you mentioned it today in your presentation but the Center for Offshore Safety and I guess my question is first of all what is the role of the Center for Offshore Safety with regard to oversight on offshore.

32.1.13 KEN ARNOLD

I think Charley Williams will respond to that later.

32.1.14 MARK GRIFFON

Okay. And secondly then, I wonder if the committee looked into because you do mention – and I agree with this – but you do mention that – I'm looking for your quote – Can they get a direction that's independent from API. And I guess I wonder if you know this was set-up partially in response to the notion of an INPO type organization and I'm wondering if you think this is, given that it has an association with API, is it an adequate organization to fulfill that role?

32.1.15 KEN ARNOLD

It's a problem of perception versus reality – I think. I think they can, they elected to be formed under API. And, Charlie can explain this better than me because the infrastructure was there that could establish an organization quickly, rather than establishing one from nothing. And, API can separate its standards-forming and it's safety-forming part from its lobbying effort. And, those of us who have worked with them think that they do a fairly good job doing that. But there is a perception that API is becoming more and more of a lobbying organization. And we had specifically one member of our committee who was very concerned about this issue and that's why we raised it in our report.

32.1.16 MARK GRIFFON

I appreciate you touching on it. And I'll leave it at that but I thank you. And I think I better, given the time.

32.1.17 RAFAEL MOURE-ERASO

Thank you, Mark. I yield my time to the staff if they have any questions.

32.1.18 BILL HOYLE

Yeah, I have one question. A number of the speakers talked about the importance of employee involvement in prevention of major incidents. And, part of that is the ability to report what's actually happening out there 24 hours a day. And, clearly, the organization needs to know that but there's only one way to get that. Employees have to feel free and encouraged to report what's wrong and free from the perception of fear of retaliation. And, in commercial aviation, they have been very successful in solving, cracking that nut. And what they've created is an anonymous reporting system where the reporting is to an independent third party, namely NASA. And they've had in this in place for a number of years and it has been transformative of commercial aviation safety, according to all stakeholders. Do you think that model would be applicable or worth considering, worth considering in the offshore oil sector?

32.1.19 ROY FURRE

I believe that could be a good solution. I believe that we have much to learn from the aviation industry and this non-punitive approach to reporting. But we have a problem that the oil industry have a deep belief in (INAUDIBLE) safety where reward and punishment is the driving force and the ideology behind it. That means that we have a long way to go before we reach the same approach as the aviation industry. But, absolutely, it's a good way to go.

32.1.20 IAN TRAVERS

Yeah, I would agree it's a good way to go. Albeit when we talk about culture and whistleblowing, I don't see how can use them in the same sentence, frankly. If you've got a good culture, you don't need whistleblowing. That must be the goal that we strive for. We've had a confidential hotline to the health and safety executive for every offshore worker since the health and safety executive became the regulator. It's rarely used now because there is that transparency, there's that ability to challenge on good operated installations. Where it's bad, the hotline is used and the health and safety executive conduct investigations. But the problem with that is because you have small groups of workers on these installations, it's very quick to rapidly identify the whistleblower. And that leaves the whistleblower reluctant to whistle blow. It's a catch-22.

32.1.21 KEN ARNOLD

I might add one of the elements of SEMS is employee participation. So, if you're doing the kinds of internal audits that we're recommending in our report and actually interviewing the staff when you're doing these audits and not just looking at paperwork, you have the opportunity to get feedback, or the auditor has the opportunity to get feedback and especially if he spends a couple of nights offshore. I've often found that if you sleep offshore, all of the sudden, the people talk to you a lot better.

32.1.22 BILL HOYLE

Thank you.

32.1.23 DONALD HOLMSTROM

I think we have perhaps one additional question. This is from Mr. Lauridsen of PSA. We've asked before with several other speakers about the developing, the development of indicators and specifically the question for indicators that are more leading. It appears from your program of risk levels that you have communicators that are more on the leading end of the continuum that have been collected and formulated to be reported on a national basis. Can you describe how you determined that was feasible and possible?

32.1.24 ØYVIND LAURIDSEN

I think as I mentioned, we have both indicators that are leading and lagging. And whether it's leading or lagging, it depends on what you set as your what it actually prevents or give you information on. We have also the questionnaire, which tried to look at the safety climates to see how the reporting culture as we're talking about, we have a question about that. We have a question about how safety is prioritized with production, for instance, how they are doing about breaking procedures to get the job done. And questions like that. And we have seen over the years, the 10 years we have done this questionnaire that these factors have improved significantly. It's better now than it was 10 years ago. And we see at the same time that the number of incident leading indicators for major accidents also are improving; they're going down mainly with a fluctuation from year-to-year but mainly down. So, I think we use the questionnaire and the indicators for major accidents together to make our conclusion at oil well trends. But the questionnaire is not so precise. We can't say that this installation have a very score on the questionnaire, they have no incidents. That's not one to one. But in big groups, for instance, we have made a study that shows that installation with no hydrocarbon leaks answer better the questionnaire than installations where they have had incidents with hydrocarbon leaks. So, we see there some connection between it. Was that answer to your question?

32.1.25 DONALD HOLMSTROM

That's good. Thank you.

32.1.26 KELLY WILSON

I have one short question. We heard yesterday from OSHA that they were interested in indicators because of the constraints on the regulator and how indicators could hopefully help them target their inspections. And I know that BSEE is undergoing some of those similar constraints with how it can target inspections or how it's going to be conducting the SEMS inspections. Mr. Lauridsen, I was wondering to what degree do you use the RNNP data and that the information that you gather through that to help identify how you do your inspections and audits.

32.1.27 ØYVIND LAURIDSEN

We use the data in the planning process where we identify the installation we want to make investigate- make an inspection on. And we use them also in more strategic levels, what areas should we prioritize for the next year. For instance, now we have top management involved in a major accident as one of our priorities, and (INAUDIBLE) and risk management issues is another priority and then we use

the data when we are going offshore on an installation, we have the specific, for instance, questionnaire results. Looking through it, we see do they have any incident reported in the RNNP. And then we can use that as the basic for our questions offshore. Our inspections – our audits I will call it – is based on systemic inspections. We must look to do the company have their own inspections, do they perform them well, do they have a good management system for safety. And then we make some verification. And that's – so we are not out checking all the instruments out in the area.

32.1.28 KEN ARNOLD

But let me add something to that. I mean BSEE is in a different position than OSHA. They have an inspection staff that has a goal of visiting every installation once a year and every drilling rig once a month. So, they are out there all the time looking at the installations. They're not waiting for an incident to occur before they go there. And their inspectors, if properly trained and we mention that in our report, could be, if you will, leading indicators of their own just by observing where there is a need for an improvement in safety culture and then helping to target more intense inspections or audits on the basis of doing that. We've also made some recommendations in our report how they could use their inspection staff in a more efficient and effective manner as well.

32.1.29 LOIS EPSTEIN

And on our BSEE advisory committee, we've been discussing what Ken just spoke to, the requirement to have regular inspections and whether that is in fact the best use of BSEE's resources, that using performance indicators, for example, or other measures to better target might be a way to get at the higher risk facilities and make sure they get the attention they deserve.

32.1.30 DONALD HOLMSTROM

One quick follow-up from Mr. Lauridsen. My understanding is the PSA actually doesn't have a large group of inspectors but you have technically competent audits that do use the data to specifically target where you see problems. Is that correct or could you explain that to me.

32.1.31 ØYVIND LAURIDSEN

Yes. We have technical professionals that are going through data and using them and going out on inspections. And we have in different areas professionals from social anthropologists to look at safety culture, psychologists and engineering specialists in different fields. So, we are a cross-discipline organization.

32.1.32 RAFAEL MOURE-ERASO

We consider this panel a real important resource that should be available for the public, too. So, we are going to continue and have some questions from the public to the panel. So, Dr. Horowitz, if you can.

32.1.33 DANIEL HOROWITZ

Thank you, Mr. Chairman. What I'd like to suggest in view of the schedule is we continue this session for another 12 minutes till 1:15, break for an hour for lunch and resume on schedule at 2:15 per the agenda. So, just for as many questions as we can handle. The first question from email comes from Pisces Carmichael of Lloyd's Register who writes: Leading indicators are a common challenge for all industries.

Can you provide one specific leading indicator for the oil and gas community to prioritize. And perhaps each one of you would like to take a quick try at that one.

32.1.34 IAN TRAVERS

I'll go. Maintenance.

32.1.35 KEN ARNOLD

I think safety culture.

32.1.36 DANIEL HOROWITZ

And how would you measure it?

32.1.37 KEN ARNOLD

You measure it by doing the inspections and audits in the manner in which it's described in our report, which would take us longer than to 1:15 for me to describe.

32.1.38 ØYVIND LAURIDSEN

I will say that I cannot point out one indicator that should do it. I think it's necessary to have a multiple kind of indicators.

32.1.39 LOIS EPSTEIN

That would be my answer as well.

32.1.40 ROY FURRE

Agreed.

32.1.41 IAN WHEWELL

Yes, agreed.

32.1.42 DANIEL HOROWITZ

All right.

32.1.43 LOIS EPSTEIN

Sorry about that to the insurance folks.

32.1.44 DANIEL HOROWITZ

Why don't we see what questions there are from the audience in the room. If you'd like if you have questions, please come up to the microphones. All right. We have a couple, a few that have been emailed. And this one is to Mr. Arnold. *Can you list some examples of the systems within an offshore organization that you*

would audit in order to indicate the existence of a healthy safety culture. I think you've just actually alluded to some of that.

32.1.45 KEN ARNOLD

Yeah, actually, all you have to do is read the various elements of SEMS and each of those has backup, the definitions of what's required under that element to be considered. So, again, rather than go through 12 different elements and all the sub-elements associated with that, please read SEMS or API RP 75 if you'd like.

32.1.46 DANIEL HOROWITZ

Okay. And a questioner writes*: Is there an argument that can be made for the automatic collection of data required for process safety performance indicators? This is similar to a regulatory or partner agreement that is used for reporting production data to ensure that the data have not been manipulated.* And the second question is: *Has the HSE offshore division in the UK considered this approach for the two indicators that were mentioned by the panelists?* Mr. Whewell.

32.1.47 IAN WHEWELL

Automatic collection of data, I think the nature of the KPIs that we're collecting means that the automatic collection is not really feasible because it needs to be collated and brought together by each installation. So, it would not work for the two items. I mean I think that as we heard from Scottish Power yesterday, there are some fair – once the system is set up, there are some fairly sophisticated means of monitoring the progress on KPIs through putting in data as for example ___ or work is completed or programs are dealt with. And that's automatically fed in and collated by the computer system. So, I mean there are automatic ways of doing it but ultimately they need to be fed in by people. And if I can just go back to Bill Hoyle's question. I mean I think that when we talk about reporting and concerns about reporting data, I think that we need to differentiate between the sort of reporting of misdemeanors and dangerous acts which obviously do create difficulties, and the reporting in a structured well-organized KPI monitoring system where the data is fed in, the culture is right, and I think the issues of whether individuals feel reluctant to report are less likely to arise.

32.1.48 DANIEL HOROWITZ

Any other questions from the room? That's all we have, Mr. Chairman.

32.1.49 RAFAEL MOURE-ERASO

Yes, so, please come back promptly at 2:15. I apologize again how things-

33 Day Two

33.1 RAFAEL MOURE-ERASO – Introduction of Peter Wilkinson

We are ready to reconvene. First of all, I would like to make an observation for clarification is that the preliminary results that were presented this morning by the investigative team of the CSB are that – are preliminary results, they are not the final results. In order for being a CSB official results, we need to go through deliberation on the board and vote on them, and that won't be done until the investigative team give us their final results. These are preliminary results. I wanted to make that clear.

This afternoon, we are going to start the session with a special guest, Mr. Peter Wilkinson. Mr. Peter Wilkinson is the Managing Director of the Noetic Risk Solutions. I'm sure that Mr. Wilkinson will explain to us what noetic risk means. And he will make a presentation to the board entitle The Effective Use of Process Safety Indicators to Drive Safety Performance Offshore. So, I am looking for Mr. Wilkinson. There he is. Mr. Wilkinson, please proceed.

34 PETER WILKINSON – Progress on Process Safety Indicators – Necessary but not Sufficient

I was hiding. I'm not sure I'm going to tell you anything about noetic risk because I judge that inappropriate at this sort of event. You'll have to come and ask me afterwards. But, thank you very much, Chairman and CSB Board and staff. But I fear you've given me a very difficult challenge this afternoon because I'm almost at a loss to know what there is to say on safety indicators that hasn't already been said probably more eloquently by the distinguished people I see in front of me. So, I think I will try and do something slightly different from what I prepared for, so perhaps this is what noetic risk means, it means I am taking a big risk now but if I fail, I fail but at least I'd rather go down trying. I think the first thing that I would like to say is that of course we're here because of the Macondo disaster and the tragic loss of lives and also the damage to the environment. My context is slightly different because I have all of that but before Macondo, we had a dramatic blowout in Australia that many of you will know about but perhaps some don't, so I'll just say a little bit about the impact of this Montara blowout.

As you can see, it turned into an ignited blowout. This is a large jack-up over a wellhead platform. And the reason I mention this context and why I'm motivated to be here and so privileged to be given this opportunity is that I make my living in the upstream oil and gas industry primarily offshore. It's an industry I love working in. And the Macondo- the Montara blowout came that close to stopping in a big way the industry in Australia. There was substantial public loss of trust, understandably, in my way.

And one company – and I their permission to say this but it's all in the public domain anyway – PTT, the Thai national oil company who had taken over a very small Australian operator were threatened with their loss of license. Indeed, they're still on probation, if you understand that term, and subject to periodic auditing, not just by the regulator but by my self and a senior colleague at Noetic Risk where we look at their implementation of the organizational improvement that were required to be made. And I'll say a little bit about that in the context of indicators. So, this is my context for you and this is really what I'm going to say. I'm going to say something about where we are now, and that's principally going to be about the various standards and documents we have on indicators. I'm not going to say too much but I am going to say a couple of things. Feel free to disagree because some of it might be a little difficult or controversial for you. But then I want to go on and say those few comments I am going to make that perhaps are not the most positive.

I'm going to move on to the very positive side and just describe some work that one of our members of the industry, PTTEP, the Australasian branch of PTT is doing, which I believe is very positive. And I know other companies are doing similar work. And I think this offers a clue actually to this conundrum that we're faced between industry or facility-specific indicators that I heard Ian Whewell talk about before and Ken talking about the culture at the other end. I believe they're at two different parts of a spectrum, but let's see if we can bring the two ends of that spectrum a bit closer together. And this is the risk I'm taking because I haven't rehearsed this and I hadn't thought of it until a half an hour or so ago.

Okay. So, my first assertion. I think there is enough evidence to back this up. We know this stuff. I'm sorry. When the CSB first asked me to say something on indicators, I said no. I think I might have said no twice. I said that it's all been said, what new is there to be said on this, and what's more, we've only talked about safety indicators, I've been – I've read, I've actually read Kaplan's book on The Balanced Scorecard. I've also read another book that's less well-known but probably as good if not better by

Eckersly- Eckerson, sorry, another American thinker and expert in this area. And if you want the references for those, they're in the paper that I wrote that backs this up, which appears on the CSB website.

So, I'm going to say something about only the last one about the OGP guidance. And OGP, for those that aren't aware, is the International Association of Oil and Gas Producers. It has all the famous names – or most of the famous names in the oil industry as members of that group. And the reason I'm going to say something about the OGP guidance – and this is the OGP Recommended Practice on Process Safety – is for that reason, this appears, it's the only specific guidance for upstream oil and gas and it closely follows API 754, which we've heard so much about.

But we've also heard about the weaknesses of API 754, so the OGP document because it so closely follows API 754 has all the weaknesses of the API document. But before you think I'm being too critical and too negative, I'd just like to remind you of what Ivan Travers from the UK HSE said yesterday. And that he said without API 754, we wouldn't be having the nature of the discussion we're having now; you have to have a marker in the sand that says how can we improve. So, I'm in the school that – to use an English idiom, although I claim to be Australian, some of you know my real heritage – I'm going to use an English idiom here because when I travel around the world, I like to spread English idiom; and that is, my pint pot – my pint of beer – is half full as opposed to half empty. So, API 754 has got us off to a pretty good start and there's more to be done.

Now, let me say something about those three main issues that have been identified with OGP in particular. So, it's got the API weaknesses, but it's got some of its own. The process safety standard is relatively easy to apply, as Ken pointed out so eloquently this morning. And I agree with Ken Arnold from Worley Parsons. Upstream processing is relatively straightforward. One we get beyond the Joule-Thompson effect, it's you know we have a bit of dehydration and compression but it's exactly as Ken said. So we can apply process safety standards easily and people can see the link in the production platform sector of the industry. We can even identify pressure relief devices, as again was mentioned, the blow down arrangements. However, my belief is it doesn't really resonate with drilling, again for the reasons that were mentioned this morning dealing with the unpredictability of the strata shallow gas and all those things that cause a drill pipe to stick in the hole as things fall in and slough off the side of the strata as we're trying to make a hole.

So, I think the language and concepts from API 754 and OGP, which closely follows it, don't really resonate with the drilling industry. They don't see them working in a process environment they build wells or construct wells. I think the – that's the first one, language and concepts. It doesn't quite fit for all of the upstream industry. I think the second two points there are inexorably linked. And just let me say a little bit more about these. Loss of containment is a very important category of major accident event. Let's be – not escape that. I'm not for a moment wishing to downgrade that fundamental. And I came into this industry after Piper Alpha, so and in some parts of Northern Europe, the memories are very clear and some raw edges still understandably. It was much more so if we go back over 20 years when it happened. I've just realized we're almost at the 25th anniversary.

So, let me say something about Alexander Kielland, the Norwegians here will be all too aware of that and will be able to tell you about that. A hundred and twenty-three people died one night, a structural failure, nothing to do with loss of containment. Ocean Ranger for Canadians here, off the Maritime Provinces in 1984 I think, 82, 84. Somebody will correct me – seventy-four people lost. Ballast control incident, fundamental issues as well as to where the portholes were that let the water in that effected the ballast control system. But it wasn't loss of containment. And near in the Sakhalin region of Arctic Russia,

the Kolskaya jack-up rig was lost in December I think of last year, November/December, 53 people lost their lives in that including the offshore installation manager who said it was madness to do what he was asked to do and resigned but it wasn't till after and he died. And, by the way, that was on a so-called wet tow. And for those of you who like the arcane language of the offshore petroleum industry, we can have dry tows as well but I'll leave you to work out the difference between a dry tow and a wet tow. Sadly, this was a very wet tow, it sank. And I'm saying nothing about the helicopter instance. But let's not forget that's why we have high intensity helicopter incidents, we have significant loss of life. We can think back to the Chinook we lost in Scotland, 44 dead, from memory. And my first involvement in this was on a tripartite group – industry trade unions and the regulator improving helicopter underwater escape training standards in the wake of the Cormorant Alpha disaster in the North Sea in 1992. I think March or April of 1992.

So, my point is here loss of containment isn't the story, we're really talking about the full range of major incidents that the upstream oil and gas industry is susceptible to. So, I'm not overly enamored with the term "process safety" for major accident events. Why can't we call them major accident indicators, or as I've done for this presentation, safety indicators. Anyway, enough of that.

So, just to summarize that. Commend API and OGP for what they've done. I don't think it goes far enough and that's why I mentioned the context at the start of this presentation because the context is with both Montara and Macondo is a significant loss of confidence in us as an industry to manage our risks. We have to do better and I don't think it's got enough really for OGP just to do a very small incremental improvement on the API guidance for those reasons I've just articulated.

And for those – if there is anybody here in the room who represents OGP or has done work with OGP, please accept what I say now is I'm a great friend of OGP and rely on my consulting work for many of their excellent documents. So, I'm not anti-OGP. On the contrary, I'm a great supporter. But we have to do better as an industry I'm afraid is the reality on this. And I've already talked about those other areas, so I'll say enough, I've done my advocacy piece there. That's the pint part half full. Let's move on to the pint part – sorry, half empty, let's move on to the pint part half-full.

So, what's industry doing? I think there's a great story to tell. And that photograph, that image is to give me a break to have a drink of water. Success story here, successfully abandoned the rig, not without some problems during the abandonment but they safely abandoned the rig without loss of life. I've just put this up here because this tells us a story about cross-industry learning. I was told very early on by a senior person in the Gulf of Mexico from a government body – not the CSB, I hasten to add – that there were no lessons to be learned from Montara. How could it be, it was a jack-up rig compared with a semi-submersible, it was shallow water compared with deep water, it was gas predominantly as opposed to oil - absolute nonsense from my perspective because if you look at these things from a certain level of analysis, we can see lots of similar problems. It's not just about the cementing or about how people remove mud and displace it with seawater because they made an assumption that the cement job, despite evidence to the contrary, they made an assumption that the cement job was a good job when it wasn't. But the key one in my mind that we can do something about is the last one as managers and supervisors in this industry. Okay, so, I'm going to talk to you just very briefly about PTT's so-called line of sight tool. If Martin Sedgwick is still in the room, I apologize, it's not as sophisticated as your system that we heard about yesterday from Scottish Power, but it's got some similarities.

So the first thing that I want to say, and this ties back to an earlier presentation that somebody gave or mentioned this morning about the importance of senior management oversight or governance as part of

the process. Not all of the answers come from senior management but senior management must know what's going on in relation to the big risks that exist. I think it was in the context of major accident risks are also huge financial risks, and therefore no stock exchange and certainly institutional investors want to know how managers are handling these things. So, there's a neat synergy between these accident risks and money and what's required for corporate governance, which is why I mentioned this and why this sort of approach can help more than just safety, it demonstrates to our stakeholders, which is more than ever necessary that we're managing our risks. So that's the purpose to ensure senior managers have oversight and how is that done. And this is where the bridge between what Ken Arnold from Worley Parsons said this morning, what Ian Whewell said. And that's by this language of barriers, let's focus on some barriers here because if we focus on what the barriers are or the controls to prevent major events, we can actually do something that's really useful from a senior management or oversight perspective that actually has a direct bearing on the safety of the facility or installation.

And PTTEP, they chose to focus for this pilot scheme on certain of those, certain major accident events that they are subject to with their drilling operation. So, this is the drilling contractor, this is the oil company who has the license working with the drilling contractor, and they chose those five major accident events. I will just talk a little more about one area because I sense it's the one you're probably most interested in, and that's going to be the unignited blowout risk. So I think the first thing I want to say here is that second bullet point. What they did was they said, well, actually, we've been well engineers, drilling supervisors, drilling superintendents, we've been contracting drilling rigs for a very long time. PTTP, by the way, is a round about 130 or so in the Fortune, in the global Fortune 500 list of companies. So it's a fairly significant multinational operator. We know what these barriers are and I think if I took six drilling supervisors or drilling superintendents, we'd very quickly come up with a list of what the key barriers are to prevent a blowout.

So I think there is some commonality we can easily work with. But they try, they started this from a fundamental perspective. They got the teams together, they got people from the drilling contractors together and very quickly they came up with the barriers that they thought were the ones to focus on. And they used bow ties to make these explicit so it was clear to everybody, which is one of the principal merits of the bow tie approach. And then for each of the barriers, they identified the accountabilities both for implementation of the barrier in practice and for recording that the barrier was actually in place, or as my last point makes clear, for carrying out the checks to ensure that the barriers are in place and working as intended.

And at this point, just before I move on to a bit more detail, I just want to put a thought in your mind that we might come back to. A common sense definition of culture is how we do around here. Some of the most important things we can do around here or around whilst drilling is to make sure our barriers are working as intended, they've been installed as intended, are working as intended, have been checked. So, I don't see a conflict between the culture and the specific facility barriers. We can actually bridge these somewhere. Exactly where we bridge them, I'll leave to cleverer people than me but I believe it can be done with goodwill and some effort.

So, let me just move on a little bit. Rightly or wrongly, the point is they have done it. And I come back to Martin Sedgwick from Scottish Power yesterday. He said the equivalent of another famous person, "Just do it." And they've done a lot of really good stuff. Well, so have these guys. Not perfect, but they've done it. And they chose 12 barriers. I've just put a sample of them up there. There is more detail, by the way, in the paper that's posted on the CSB website. If you think they're wrong, well, that's fine. You're

entitled to make that assumption. But it's what's working for them at the moment whilst they get started and see what works in practice.

I guess by now you've already read that slide and can see the similarities with Scottish Power's presentation yesterday, particularly the third bullet point. It's not as pretty or as sophisticated as the symbols, the symbology used in the Scottish Power example, but it gives the same results. It's the results of the checks and the checks are done when it's appropriate to do the check. So, I was offshore on the Ensco 109 almost exactly three weeks ago when they completed a famous well, it was the Well H1, which was involved in the blowout and it was side track two and whilst I was there, it was completed, perforated and tested. And, of course, when they came to test well was when they perforated the well, the well barriers were different and they were signed off, there was a lubricator and (wire) lining. That went away, then they put a Christmas tree on and the barriers changed again and were signed off.

So, in that point in the activity, there was lots of changing in the barriers but they were recorded, went into the IT system. And wherever you were in the company, they appeared on your IT screen. No hiding place. If it hadn't been done or there were problems with it, you would know about it, so in the company. And the reason I say that you'd know about it in the company, PTTP provided an induction in addition to the rig owner's induction and this is what their induction said about major accident events. Now, I think it was Ian Travers from UK HSE who has put the challenge out there for the people that have something other than lost time incident data at the gate to the factory. Well, on the induction of going on the Ensco 109, drilling for Ensco, I was told this about the Montara blowout. None f the H1 well barriers – this is the ST-1 well, but it was the ST-2 when I went there.

None of the well barriers complied with the well construction standards, rig personnel demonstrated a manifestly inadequate understanding of the well documents. Senior personnel on and offshore were deficient in decision-making and judgments. Records and communications management were deficient, failure of communication between PTTEP and (INAUDIBLE) personnel, failure of relationship between PTTEP and the rig operator; onshore management and governance structure defective. Cost minimization. What I liked about this was the openness and transparency and frankness from the company; the only way to go at the moment in Australia in an attempt to rebuild this trust we've lost. And, the last thing I would say is that this sounds like a bureaucratic impostor or could be alleged to be. I went out of my way to talk to Ensco personnel because, of course, Ensco has got an important stake in this. They've got to do much of the stuff that work very closely with PTTEP to make sure all this works.

Ensco were very – were a very simple response. And I've been on lots of Ensco rigs from the early 90s. They're in different parts of the world. And they said, "We are doing this stuff anyway." So, that's my second point, really. Industry is doing it. PTT are doing this stuff. And I think we should keep – just hold this idea I've put out there. There is a way forward and I'm not saying this is the way but I ask that we explore it. Okay, you'll be much relieved to know that I'm almost at the end. I've got just two slides after this one to go. So, I ask you to accept and recognize that the OGP recommended practice is not sufficient. I'm not talking about people's intent, hard work. And I can assure you I know what it's like working on committees with multiple stakeholders. I've worked on international committees, which makes it even more difficult.

So I understand the burden and difficulty that API and OGP have had in getting agreement. And as I said earlier, without the API work, we wouldn't be having the discussion at the same level that we're having it; so, I'm not being critical about that. But it has got problems. The OGP stuff doesn't really work

for all parts of the upstream industry. Process safety works for the production side, not so good elsewhere and we've missed out some really important major incident types from my perspective.

I think Ken mentioned a recommendation, Ken Arnold from Worley Parsons mentioned a recommendation in the works that he reported on in the last panel session. Again, can I say yep. Surely we can all get behind that sort of recommendation. Let's do it. My codicil to that is that let's make sure the workforce are involved. And I then I thought – hang on, it's not just the workforce; what about all the contractors, both rig owners and third party contractors. They've got a very important piece in our industry. And we need to make sure they are fully engaged and involved in this. It's not just companies and workforce, it's all the key players. So, that would be my take on that. And, I'll just go back to this idea I've put out there that it's not a culture out here for leading indicators or loss of primary containment down here is a lagging.

I think where we can bring this together more if you accept an approach to culture that is based on something that's, "Well, this is how we do things around here," because you could argue that culture is an outcome and not a process. And if you accept that second view as well and that culture is the product of the activities which take place, and the most important activities are about implementing barriers that can stop major incidents, I think we can come to a halfway- a halfway measure.

Thank you very much, Kara. I'm so pleased we didn't lose the very last slide because I did want to – oh, have I gone past that already, it defeated me. I was going to show you, I have no idea whether you saw the slide with the picture. There we go, got it back there.

So, where I'd like to finish up on that, it's not culture at the leading end, loss of primary containment at the other lagging end; let's focus on those barriers. And, I know that we all are selective in our hearing in these sorts of events, but I think I heard lots of discussion around barriers as being at the barriers or controls and they are at the center of what we do in relation to major accident prevention. So, thank you very much for your time and attention. Thank you for the opportunity to speak and thank you for allowing me to take a risk.

35 Day Two – Panel Discussion on Industry

35.1 RAFAEL MOURE-ERASO – Introduction of Panels

Thank you, Mr. Wilkinson. Mr. Wilkinson, I would like to ask you now if you will join the panel over here. You will be in that panel for us to ask questions when we ask questions to the group. And I would like to invite the panel to please sit in the front table. In the panel, we have Mr. Wilkinson that we just heard from and also we have Mr. Charlie Williams who is the Executive Director from the Center of Offshore Safety. We have Mr. Bob Lauder from the Health and Safety and Policy Manager of Oil and Gas from the United Kingdom. From Norway, we have Dr. Aud Nistov – that is my best Norwegian – for the Health and Working Environment, Safety and Security Manager and current Acting Director of HSE and Operations for the Norwegian Oil Industry – the Norwegian Oil Industry Association, OLF. Also Mr. Gunhild Holtet Eie. I'm sorry. Miss Gunhild Holtet Eie. It's Eie. Competence Centre for Norway. And, Mr. Joe Stough, the Vice President of Innovation Technologies from the USA. So, that's our panel and I am going to ask Mr. Williams to start his remarks, please.

36 CHARLIE WILLIAMS – Center for Offshore Safety

Thank you very much. I appreciate the opportunity to present to the Chemical Safety Board and I wanted to talk about a new industry organization which is the Center for Offshore Safety. And I also want to thank Ken for his fine explanation that he always does about RP 75 and SEMS. So, I'm going to say in my discussion, I'm going to talk a lot about SEMS and I'm glad he described SEMS so well in his presentation. So, Center for Offshore Safety is unique in many ways. The first unique thing about it is that we're focused on one single mission; and our mission is to promote the highest level of safety for offshore drilling completions and operations. And so that's our mission and it's a single-focused mission. We're going to achieve that mission focused on one single thing, and that's SEMS. So, we're going to focus all our efforts on SEMS; and not just SEMS the process but there's a lot of discussion around all the embodiments of SEMS and all the aspects of SEMS, so there's effective leadership, communication, teamwork.

There's the SEMS system itself. And then we're also committed in the Center for Offshore Safety on third party auditing of SEMS systems. Also, you heard about the link between SEMS and safety culture and how they can work together to develop and maintain and make more effective safety cultures, and, in fact, work on responsibility and accountability and safety. So, we're going to be focused on safety and focused on SEMS and use that as our tool. And there was just a discussion around process safety. When I look at when we talk about SEMS and we talk about process safety, we're talking about the process of executing the work. And we think that RP 75, which is the fundamental part of our tools since we're doing our work around the workplace safety rule that BSEE has put in effect. We think it's fine for all types of work processes.

So, like I said, we're focused on drilling and on production and on completions and even on marine operations. So, what areas are we working in? Fundamentally, we wanted to be a platform where the industry can come together with other stakeholders like the government and actually talk about SEMS and how SEMS can be effectively implemented, how it can be improved and how we can work together and share information that will improve the SEMS implementation. We're working really in three fundamental areas. The first one is auditing. So, this is really around the auditing and measurement of SEMS, SEMS implementation and SEMS effectiveness. And even though we're a relatively new group, we've actually been working for over a year on auditing and auditing of SEMS systems.

Now, there's been a lot of people ask me, well, you know so is that the most important thing you do at Center for Offshore Safety. It's not the important thing we do, but the reason we put so much focus on it is because it became a regulation in the US and so people needed, because it was now a regulation, people needed audit tools and audit support around auditing SEMS systems. So we put a lot of effort into that work. Now, auditing is always going to be important to us, though, because the feedback from the auditing is going to come back to the Center for Offshore Safety and really that's one of our first fundamental safety performance indicators is the audit results from the SEMS audits that are now required as part of the regulation. Also of course, people can do these SEMS audits just to gain their own information around their SEMS systems. And then also part of Center for Offshore Safety is you can do the SEMS audits and get a certificate showing that you've complied with the SEMS audit.

The other key thing that we're going to do is really on measurement and evaluating that measurement, learn from the measurement and see what gaps there are that need to be closed around safety environmental management systems. So, the first tool there will be the audit results that come in.

But we're going to use all the available information that we can gain, so we're going to get leading and lagging indicators and we're going to cooperate with many other groups. You know, we've been talking with OGP about their data gathering. So, we want to be a centralized place to gather data, to learn about SEMS and SEMS effectiveness and what the gaps are. But we're also going to do safety performance indicators beyond this auditing. And I'm going to save that for last, since that was really the topic of what we're going to talk about. I just wanted to give a brief overview of what we're doing.

So, gap closure; so how are we going to do gap closure. That's the third major thing that we'll do. So, we find the gaps from looking at the information and we're going to do gap closure through workshops and forums and developing good practices. And we're also, if need be, feedback that we need new standards or new recommended practices or if we need revisions to existing standards and recommended practices. And that's one of the reasons that we're linked with API is because we want to be able to feed back into the standards process any work that we see that needs to be done to support the SEMS systems.

So, a little about governance. There was a question around the Center for Offshore Safety and governance. You know we were created, affiliated with API, but we have a significant amount of independence from API. We have our own board, the board has API members and API non-members, it has drilling contractors, it has larger operators, smaller operators, and it also has service companies and manufacturing companies. So it has a really diverse board that includes – and I wanted to point out that it's unique in that regard in that we represent everybody and the contractors that are there, the drilling contractors and the other contractors that are part of COS have all committed to doing these third party SEMS audits just like the operators. There was a lot of discussion earlier around contractors.

These contractors are going to do those, have committed as part of being a member of COS to do those third party audits of their SEMS systems as well. We also have an advisory board that's going to be set up to advise the board and it's going to have the other stakeholders, you know the Coast Guard and BSEE and all. And, then, of course, we have the Association of the Third Party Auditing Group that is going to actually do the audits. But, talking about the other discussion around association with API, I think as everybody knows, it's part of standards and recommended practices. It's been going on for over a hundred years. It's actually a completely separate group from the lobbying group as far as the API staff. But, creating those standards and RPIs done by thousands of people that actually work in the industry that come together and create those consensus standards, that's all a completely separate process.

Part of supporting that process is auditing and the monogram program which is used with manufacturers to assure compliance with the product standards that are generated there. So, it was very useful to us and COS to be tied in with this auditing because we're going to do auditing, too; and, to be tied into this expertise around what's essentially a quality assurance process. So, that's why we were linked together and that's our governance. So, I wanted to mention about some of the things that we already have developed. So, we spent this year working on audit tools. And the kinds of tools we have, we an audit checklist that auditors could use. And if you do this audit, you know we've communicated with BSEE around the audit and you can use this audit also for your official regulatory BSEE required audit of your SEMS system as a guidance document that guides auditors in how you use the checklist.

We have two other things that I think are pretty interesting is one we call the Compliance Readiness Worksheet, but the simplest way for me to explain that is it takes the audit checklist and turns it into a bridging document because it goes down and says on all of these elements of your audit of your SEMS system – and we have over 200 questions in the audit, they're all tied back to RP 75 and tied back to the regulation – on each one of those, it goes through and talks about the record-keeping requirement

and also whose responsibility it is for each one of those items. So you can go through with your contractor and decide responsibility around those SEMS elements. Another thing we have is called the Operator-Contractor Letter Template. But, essentially, it's an agreement, it's examples of agreements that you can execute with your contractor that discusses the responsibilities and commitment that the contractor has to SEMS. And, again, it's another form of a bridging document that talks about how their SEMS system is going to work with your SEMS system and what their obligations are.

So we have a significant commitment of the contractors to participating in SEMS, even though it's not part of the regulatory requirement right now. Now the other thing that we're just finishing up is again about auditing. And besides the audit checklist, the other things that we're doing is we're working on specific training for auditors that audit SEMS systems. So, these third party auditors will be certified and audit service providers will be certified by the Center for Offshore Safety. They go through a specific training program about auditing SEMS systems. And they will then be accredited audit SEMS system and then the people that want to get a SEMS audit can choose from these audit service providers. But then we'll also go back and periodically from the Center for Offshore Safety audit the auditors to make sure that the process is going well. So we have a whole set of both training control systems over auditing SEMS. And those will be – you know we're in the process of approving those right now, it should be within a few weeks we'll have those documents approved.

Now, the other things, we've got quite a list of tasks that we wanted to achieve. We're really trying to do those in a priority fashion. I thought I'd mention the four tasks that we have going on right now in addition to the discussion I had about auditing. One of them is data backbone, which is a really a place to put all the information we gather so we can use it for analysis and learning. The other thing is really about how we're going to learn. So we've just started this group up but this group is going to, this task group is really going to look at how do we, from this information, how do we actually glean learning because our fundamental thing is about this learning and continuous improvement and improving our effectiveness. But then the third one that I'm going to talk about is the safety performance indicators themselves. And but then the other one I wanted to mention is a good example of how we're going to do gap closures. So, in addition, in advance of really having the information about the gaps, we said we want to go ahead and start doing some workshops to learn how to do this.

And so the first one we've done is on leadership site visits. So we have – excuse me – a group right now that is working how can you effectively do leadership site visits to support SEMS, what's the messaging to the staff on the importance of SEMS, on your personal views about SEMS. Actually, what you want to observe there is a leader that can teach you something about SEMS and the SEMS effectiveness at that site. And so there's been a lot of discussion about the importance of leadership and the importance of what leadership does and says and how they support SEMS. And, so, we're going to come out with a good practice that will help leaders prepare for leadership site visits. So, that's an example is we find these gaps from the learnings of the things that we're going to do to close the gaps and that will be an industry good practice.

So, now let me turn to talking about actually safety performance indicators themselves. And one of the – I was glad we had good discussion around barriers because I think we're really doing our safety performance indicators in maybe a little bit different way than other people have thought about safety performance indicators. And so what we're doing is we're focusing on protection for major events and through the safety performance indicators. And the way we're doing that is focusing on barriers. So we're actually using the bow tie analysis. Of course there's other similar kinds of analysis. But we're using this focus where you identify your major hazards that lead to the top events and then you build the barriers.

And so what we are saying is our safety performance indicators are going to be the things that could be a threat to your barrier. So we're saying the indicators should be tied to the barriers and tied to threats to barriers.

So, we don't have all these done yet. We're working on them right now. But just to give you a couple of examples for the concept of it, if you have, if you're drilling a well and your concept in drilling this well is I'm going to have a two barrier system while I'm drilling this well, then a potential measurement is I lose one of my two barriers. So it's not an incident per set because there's not a loss of containment, but you've lost one of your barriers. So you have to stop and reestablish that barrier. Well, measuring that is an indication if that happens too frequently that you have some problem with your process.: And so that would be a safety performance indicator and a process measure. Similarly if you had a high-pressure vessel, you could say well I have one barrier here but if I have too much deferred maintenance, you know that would be a threat to that barrier. And so that's what we're really focusing on is those and we're focusing on this not just in drilling but we're doing drilling and completion and operations and marine. So we're building these bow ties and looking at these bow ties and then building the safety performance indicators based on looking at these barriers.

And the key thing for us is having the safety performance indicators teaches some things, it's a learning and also it can be an actionable item. So those are two of the keys of what we're doing about that. And as was talked about earlier, the nice thing about doing it this way with barriers is it also you know it can be set operational limits because you could say an operational limit is if I have a two barrier requirement and I lose one, that's a limit. And, so, it can be used for that. It can be used for a discussion item with the workforce on location about what are the key barriers, why are they important, what's the barrier you maintain, how do you take care of that barrier, and also be a key communication tool with your contractors on what barriers are contractors maintaining and what barriers are the operators maintaining.

It can also be a key communication tool with your contractors on what barriers are contractors maintaining and what barriers are the operators maintaining. So, in addition to being a good measurement, it's just we view it as a really good communication tool. And the other thing is we're also looking at learning from high potential events and part of the learning group that it's also tied in with our group on safety performance indicators is talking about how we're going to define high potential events, how we're going to feed that information back in and how we're going to learn from that information.

And the other thing that I mention in closing is when we did set up the Center for Offshore Safety, we went and looked at many similar organizations and tried to choose what best fit the oil industry from that. And we're doing the same thing now as far as safety performance indicators. So we have a plan to meet with all the organizations that are doing similar work so that we can collaborate and get good value back from other groups doing that. Thank you very much.

36.1 RAFAEL MOURE-ERASO

Our next speaker is Mr. Bob Lauder from the Health and Safety Policy Manager of Oil and Gas United Kingdom. So, Mr. Lauder.

37 BOB LAUDER – Major Hazard (Asset Integrity) Key Performance Indicators in Use in the UK Offshore Oil and Gas Industry

Thank you, Mr. Chairman. Thanks also obviously to the board and staff of CSB for this opportunity. The opportunity as we see it is to share real experience from the UK in terms of developing and managing a program of key performance indicators that are linked asset integrity and major hazard management. It's necessary for me to do a bit of a history lesson and also a little bit of a tutorial in actual fact on some of the regulation that's in place, so for that reason, I've chosen to use some slides and hopefully you'll bear with me. They are quite pictorial in nature, so hopefully they fit the bill.

Just before I start, there was some commentary this morning from some of my UK colleagues from Ian Whewell and Jake Molloy, and just to give some context there, there was a conversation this morning on the tripartite approach that we look to adopt in the UK. And just as evidence of that, Ian gave you the regulator perspective, Jake Molloy then followed up with a workforce perspective. And Oil and Gas UK are the trade association who represent the employee and companies in the UK offshore sector. So we have 266 member companies covering operators and the supply chain.

The contracting part of the industry. There's drillers in there, there's all the operators that everybody in the room would probably be familiar with and many more besides. Okay, so, in terms of asset integrity and major hazard management, I would really like to be here saying that that we're an unblemished industry in the UK, that we have no baggage in terms of major accidents. But, sadly, there has been some mention already this morning – is it that one, okay I thought it was this, my apologies. Obviously, there has been mention this morning already of a particularly significant that occurred in the UK sector of the North Sea, Piper Alpha.

You see the date there alluded to a minute ago. Next year will be the 25th anniversary of Piper Alpha. You see the number there, the casualty count, 167 people killed and 166 of those onboard the installation and one heroic guy in a fast rescue craft trying to take people out of the water who were in some distress obviously. Sixty-one people survived that event but what the tale doesn't tell is that of that 61, a great many were very seriously injured very badly. Burned, for example. A great many people made their escape by jumping off the heli deck some 150 feet above the sea. People climbed down crane jibs to make their escape. It was by any measure, a catastrophic event. It was, however, also a transformational event. The transformation came in the form of the Cullen Inquiry, which was a public inquiry launched by the government of the day, chaired by Lord Cullen, a very eminent Scottish judge. And many people would say that he produced what still is the seminal work in terms of a follow-up inquiry report, the Cullen Report. That made 106 recommendations and prime among those recommendations was a radical overhaul of the regulatory, the legislative regime that existed in the UK at the time.

And basically what happened was we moved away from forms of prescription which told us exactly what we had to have in place to a much more goal setting and risk-based approach. At the core of that approach was the recognition and management of major accident hazards. So, very quickly along that line there and don't propose to go into huge amounts of detail, I'll say at this juncture that we have put on-CSB have already have launched their website a more detailed technical paper which gives more of an insight into what I'm scampering through at the moment for the expediency of time. Essentially what we have is our safety (case) regime and I know CSB has explored the concept of safety case, it's a well-established and well-defined concept now as it happens. But the safety case is at the core of the regulation.

That compels the duty-holder or the operator of the production installation, for example, to identify a range of major accident hazards. You'll see some example up there – fire and explosions, structural failure, etc. Kind of echoing some of the earlier comments that it isn't just about hydrocarbon releases; there's a whole spectrum of hazards that exist.

I'm kind of moving on. And this is really where we get to the nub of what I want to be talking about today in terms of key performance indicators. For all of those major accident hazards, we have to describe, we have to identify and describe the safety critical elements that relate to that particular hazard. So, those elements are in the form of plant and equipment. If I use the exact legal definition, it's part of the installation the failure of which could cause or contribute substantially to a major accident or the purpose of which is to prevent or limit the effect of a major accident. So it's kind of two sides of the major accident coin, if you like. And in box four there under safety critical elements, you'll see there that what they're doing is preventing, detecting, controlling or mitigating accident hazards. Further, for each of those safety critical elements – and we're talking here things like fire water systems, structural integrity, etc., etc. - for each of those, we have to write performance standards which describe what the performance of that particular element is, how it's made reliable, what it's reliability aspects are and how it's going to survive in the event of a major accident. And then the real key to what we're moving on to talk about just now is that for all of those things, we then need assurance activities that the duty-holder undertakes to make sure that the safety critical element will perform on demand, will do exactly what it's meant to do when it's expected to do it. And at the end of that line, and again pretty key to what I'm moving on to talk about, is that all of that scheme, the whole wrapper if you like, is called verification. And that's scrutinized. There's surveillance activities undertaken by an independent and competent person. And these are people who are entirely independent of the duty-holder whose scheme is being scrutinized.

They're competent engineers. They come from companies like Lloyd's, DNV, ABS, Bureau of (INAUDIBLE), etc., etc. And their function is to make sure that the duty-holder is doing what he said he would do to those safety critical elements to ensure that they perform, as I said, on demand. And he can do that in any number of ways. Okay, so, we've had that in place, that particular regime. So, that's been in place, the safety case regulation since 1992. So, they're in their 20th year and most of the supporting regulation that came along with that was from the mid-90s.

So, Jake Molloy kind of stole my thunder a little bit this morning because as he's inclined to do being a union man, Jake gave some considerable mention to the role that the health and safety executive, the regulator made in driving improvement. And nobody would deny that that's the case. The key programs that Jake talked you through this morning were very, very critical in terms of our development. And, in particular, key program three from 2004 to 2007, asset integrity, that was a very intensive program of inspection as Jake referred to this morning. Looking at the physical condition and the way that was being managed on our installations.

And you know it pains me to say that that really was a wakeup call for the UK offshore sector. The findings were not what we wanted them to be, there were significant shortcomings in our asset integrity management. It was actually a wakeup call for the regulator, if I can say in passing, because obviously they had failed to detect some of these findings until we went looking in a different way I guess. Our regulator may have a different view on that, but that's my view. The – what that brought to light was that obviously we hadn't been monitoring properly, we hadn't been looking properly in the right places to make sure that things were in good condition; and, therefore, we had failed to spot these kind of latent defects, if you want to describe them as such. So, what was missing then quite clearly was our performance

measurement aspect of major hazard management, and that's what gave rise to the KPI scheme that you see kind of summarized there and I'll move on to describe in just a bit more detail. So, essentially, we've got one lagging indicator. If I can reinforce at this point that this is an industry-level scheme, so this is looking across the UK offshore sector. And that's very much underpinned by the operator or company-specific performance indicators which will include these but also include some more indicators if you like in a much more detailed sense they will be there.

So, we've got one lagging indicator, which I'll go on to talk about hydrocarbon releases. And we have two leading indicators. We are just reiterating what a number of speakers have said – we don't get too hung up on the semantics of this. There are some who say that the middle one, KPI-2, is a bit of a hybrid. And you'll see why that is when I describe it to you because there are some elements of failure already having occurred when you get to that particular point. So, essentially, and you know I have to say at this point that I'm not here to analyze, interrogate or defend the actual performance numbers that we're showing you. It's really just to let you see the scheme as it presents to us. What we've got there are KPI-1 hydrocarbon releases. And, all of the KPIs, I think there's a point that's been made by a number of speakers, all of the KPIs are measuring existing arrangements. Okay, so, there's nothing being generated from scratch, there's no absolutely new data acquisition requirement being imposed on operators. These are things that they're already measuring and gathering data on.

And as you can see there, we've been gathering, we've actually been gathering data on hydrocarbon releases since 1992 in fact. But the screen there shows you the picture from 96. And, essentially, what we measure are major and significant hydrocarbon releases on the yellow line and on the blue line are all releases which will include the major and significant. And without going into the detail, a release becomes significant when it's in the range of – if I use gas as the release agent – as in the range over 1 kilogram up to 300 kilograms. If it's over 300 kilograms, it becomes major. And if it's below 1 kilogram, it's a minor. But all of those are captured in the dataset. I'll not go into too much more detail.

There is some almost bragging we can do here but I'm going to avoid doing that because Jake mentioned this morning we did set ourselves a three-year target back at where you see the numbers 187 on the blue line and 85 on the yellow line, a 50 percent reduction target. Huge amount of focused effort going into achieving that target. And you know at the end of the year, just using the HSE reporting year, we're very much on track to achieve that, yeah. I should just say, by the way, this data comes from the Health and Safety Executive from the Regulator, so these are reports that submitted by duty-holders and then find their way back to us. Okay, this is one I wanted to – I actually slipped up and stuck this into my presentation yesterday. I didn't have it originally. But there was so much talk yesterday and again today in fact on public disclosure or external reporting if you like. And that was a bit of a divide that the UK industry wrestled with for a long, long time as well.

There was significant reluctance on the part of lots of companies, that has to be said, in the UK to go as public as we've now gone with our statistics if you like. So, what we do now is again we get this information directly back from the Health and Safety Executive from their managed database. And, on a quarterly basis, we put it on our website so it's publicly available. And then the paper we have submitted to the CSB website. There is a link. You can go and look at that. And, on a quarterly basis, we – I hate to use the phraseology, but it has been called naming and shaming.

You can see that we named the duty-holder, we named the installation, and then we give some indication of the nature and scale of the release. So, that's out there. It's seeable by anybody who wants to

see it. A point I might want to make here is you'll see some very familiar names on there that are companies who obviously operate in this particular province as well. So, I think that really was a big deal for us to begin as transparent as we now are with that and it didn't happen overnight and it didn't happen without some resistance. But it's happened now. So, we are there. Okay, I'm moving on. I'm very conscious I'm using more of time than I should have done. KPI-2 are verification findings. So I mention the independent competent person, when they look at the duty-holder's arrangements for inspection, testing and maintenance of their safety critical elements, they then raise findings should something be amiss.

A level two finding, if I give you an example, if you have a deluge set, okay so something that is part of your active firefighting system. If it's not proving the right amount of water as per the performance standard in a given period of time as per the performance standard, that would typically be a level two finding. So, it's a finding specific to that particular piece of ___. And what we track here and I should say all of this data comes from 21 contributing companies and all of those again are very familiar names to you, they're all the major players and some other players who are a bit less than major. And that was a thought that had come to me as reflecting on what we're doing here. All of the companies in the UK who undertake this level of assurance, if you like, or performance indication, they're operating here, so a thought that comes to me, if you're in British Gas in the Gulf of Mexico or Shell in the Gulf of Mexico or wherever and you want to see how somebody does in the UK, you don't need to come and talk to Oil & Gas UK, you need to go and talk to Shell in Aberdeen or BP in Aberdeen or whatever because it's actually happening within the companies.

Okay, I'm moving on very quickly. That's findings per installation. And then at the top end of criticality, level three verification findings are systemic failures. So, if I use that fire pump analogy again or the fire water delivery analogy, what a level three one would kind of relate to was that your system was not adequately revealing any failings in your testing of a fire pump, for example. So, it would be a much more significant finding. There's much less of them as you can see there.

Way back in the day, you can see we started with 35. And I think I failed to mention along the way now that we've had this system in place for three full years and so we've got quite a body of data now. We also measure planned maintenance backlog. And, again, I'm not going to interrogate this in any way. But that's showing you man hours per installation. And, again, we get this per quarter. Something else I should mention is that we don't just publish the data, we don't just send this out in emails. We actually have quarterly review meetings where people from those 21 contributing companies get together.

They're usually integrity managers, maintenance managers, people of that ilk. And we review the data and we kind of interrogate and get some intelligence from it where it's possible to do so. So, we measure planned maintenance backlog. We've also got a category called deferred maintenance. The distinction there is that the deferral process is usually much more rigorous in terms of its assessment of suitability to defer or acceptability to defer a piece of maintenance. So you do apply some form of risk assessment. Is it okay not to do that piece of work in the particular timeframe that it was supposed to be done? So that's what deferred maintenance looks like. I'm very conscious of time, so I'm going to move on very quickly. Because we've been in place for three years, we've got a relatively mature system. We're having a bit of a review, refresh and improve mode. We're absolutely convinced that those three indicators are okay. They still fit the bill. They still look at the barriers that are in place to manage major accident hazards and they are valid.

And all we're doing is we're kind of improving some of the aspects of them. I'll just use this one very quickly because this is a recent improvement. The smart numerical people in the room might have noted that if all you do is look at the straightforward man hours of backlog per installation, that really doesn't tell you a story, it really doesn't tell you whether that's good, bad or indifferent. The story I always use to illustrate this is if you look at man-hours on an installation, if that was 100 of 1,000, you might be okay with that, but if it was 100 of 200, you probably would not be okay with it.

So, we're moving now to what's a percentage measurement as well. And this is going to give the opportunity for the practitioners for the professionals in this game probably to target that, to say well, 10 is okay, anything above that, we've got some kind of action trigger point or whatever. So, that's something we're doing now. And, in the interest of time, I'm just going to close here. And I've got essentially that one there again is looking at how much ICP activity we're managing to execute to undertake. And you'll see it kind of bumbles around about the 90 percent mark. That's probably explainable. And I did say I wasn't going to try and explain or justify but a lot of the activity takes place offshore and you have to get the ICP offshore and a time that coincides with an assurance activity, a fire pump test or whatever. So, sometimes those are the kind of challenges that make life a little bit different. So, the kind of summary statement I wanted to make was that we are pretty sure this hangs together as a performance measurement tool as a means of getting some kind of assurance to people who need to be assured that major hazard management systems are in place, the barriers are as effective as they need to be. A point I would make however is that it's really not about the indicators, it's about all the work that goes on behind the indicators to make sure that you are maintaining your safety critical elements and maintaining the integrity of your installations.

And all the indicators can do is kind of shine a light on that activity and tell you whether you're getting it right, more importantly, telling you if you're getting it wrong before something does go badly awry. So, with that, I'll close. Thanks very much.

37.1.1 JOHN BRESLAND

Can I ask you just a quick question before I forget it. Go back to the deferred maintenance slide. Is that a good slide or a bad slide from your perspective?

37.1.2 BOB LAUDER

We estimate it, we assess it to be a good slide because the deferral process, as I mentioned to you, is a robust process, there is a risk assessment aspect to that which really challenges that deferral, the resetting of the clock as we call it. So, if you're not going to manage- maintain the pump or calibrate the piece of equipment in this period, you're going to do it in the next period, is it okay to do that. That's the deferral process. The other planned maintenance backlog may not have been subjected to that level of rigor in terms of assessment. It's just what's undone, basically.

37.2 RAFAEL MOURE-ERASO – Introduction of Aud Nistov

Thank you very much, Mr. Lauder. Our next speaker is Dr. Nistov from the Health and Working Environment, she is the Safety and Security Manager from the Norwegian Oil Industry Association and currently the Director of Health and Safety and Environment Operations. So, Dr. Nistov.

38 AUD NISTOV – Statement from the Norwegian Oil Industry Association (OLF)

Thank you. Mr. Chairman, Board Members and staff, colleagues, on behalf of the Norwegian Oil Industry Association, the OLF, I would like to thank the US Chemical safety Board for the invitation to visit it. And I appreciate the opportunity to speak on process safety performance indicators for major accident prevention from a Norwegian perspective. I have submitted a comprehensive statement to the CSB, but rather than to read this, I will summarize my statement covering the six main topics as shown on this slide. Let me start by placing Norway on the map. Norway is located in Northern Europe and even though it's not a large country, the Norwegian Continental Shelf, the NCS, is vast. The Norwegian oil and gas exploration and production is located offshore on the NCS, and onshore, we find gas processing plants, refineries, etc.

During more than 40 years of petroleum activities on the Norwegian Continental Shelf, we have gained solid expertise with regards to offshore operations in rough waters. Norway represents the second largest exporter of gas in the world, while we are in sixth place when it comes to oil exports. Norway is therefore a key player with regards to accommodating the world's energy needs. The Norwegian Oil Industry Association or the OLF is a professional body and employee association for oil and supplies companies engaged in the field of exploration of oil and gas on the NCS. The OLF represents 48 oil companies and 47 suppliers and a total of 35,000 employees.

As mentioned earlier today by Norwegian colleagues, the trends in risk level in Norwegian petroleum activity, the RNNP project, is the most important achievement made by the Norwegian petroleum industry with regards to safety performance indicators. The objectives of the RNNP are measure the impact of the industry HSE work, contribute to identified areas that are critical for HSE, and increase insight in potential causes of accidents and their relative significance for the risk profile.
This work is built on cooperation through the tripartite model. The tripartite cooperation between industry, trade unions and governance in the oil and gas industry in Norway is unique in both a national and its international perspective. The development of the RNNP project has taken place in multipartite collaboration where there has been agreement regarding the prudence and rationality of the selected course of development as regards to forming the basis for a shared perception of the HSE level and its development in an industry perspective.

The work has been awarded an important position in the industry in that it contributes toward forming a shared understanding of the risk level. This example from the RNNP reporting shows the development in a number of reported defined hazards and accident situations during the period from 1996 to 2011. You can see – or you might have seen if this slide were better – that the main risk contributors regarding major accident risk on the NCS or well incidents, hydrocarbon leaks and ships on collision course. And I'm showing you this because as a result of this trend in risk level, the industry's strategy and goals for the 2012 and 2014 periodic focus exactly on these HSE priorities in major accident risk reduction through projects regarding well incidents or hydrocarbon leaks and ships on collision course.

Many papers and studies have discussed what are the critical characteristics of effective indicators and the list provided here represents the view of the Norwegian petroleum industry. I will not go into details but I would like to highlight some key points. Major hazards in the offshore industry are rare events on a national level and major accidents are very rare in all high reliability industries. In the last

major accident in offshore operations on the Norwegian Continental Shelf occurred in 1985. But even major hazard producers such as hydrocarbon leaks, well kicks, ship on collision course, etc., are rare events on a single installation or company, typically in the order of one event per installation per year. Therefore, it may be difficult for the offshore employees and the managers to recognize and understand the significance of major accident risk producers unless these represent easily observable performance. The indicators should preferably be intuitive in the sense that what is measured is considered intuitively by the workforce to be important for the prevention of major accidents. Psychological and organizational reasons could in many cases also result in biased reporting. As an example, we may think of an organizational incentive structure where absence of incidents is rewarded, for instance, by a bonus scheme. This may result in that there might be a risk that some incidents are not reported as the incentive structure is interpreted as rewarding the absence of reported incidents. Therefore, it would be very useful if the indicators could reflect as closely as possible the hazard mechanism. If they do, then the indicators may contribute to maintaining awareness about the risk mechanism.

A risk indicator must also be sensitive to change and a good set of indicators will reflect changes in risk as well as point to aspects or improvements should be sought. And, finally, this leads us to the requirement of validity, which is a critical point in the evaluation of the quality of an indicator. Is the indicator a valid indicator for the major accident risk and does the indicator actually measure what we intend to measure.

RNNP has developed two types of indicators with regards to risk associated with major accidents or major hazards on the installations. The first category is indicators based on occurrence of incidents and near misses, that is, the precursor events. This picture shows the major hazard producer data or the categories of major hazard producer events that have been included in the RNNP. And that's shown the industry is a major contributor providing data to support these indicators. And precursor event occurrences are lagging indicators, the risk level has changed at least temporarily when the producer events occurs. The second category's indicator is based on performance of barriers that are installed in order to protect against these hazards and their consequence potentials. RNNP has collected these barrier data for major accidents since 2002 and barrier indicators are given high priority in the RNNP due to the rare occurrence of producer events.

The main emphasis has been placed on barrier elements that are associated with prevention of fire and explosion, but also structural and marine system barriers are addressed to some extent. The most relevant indicators found in RNNP considered as leading indicators are indicators based on performance of barriers that are installed in order to protect against major hazards. And, as pointed out by many of the other speakers yesterday and today, major incidents rarely result from a single cause but rather by multiple failures that coincide and collectively result in an exceptional event with severe consequences. And this relationship between sequential failures on multiple risk-controlled systems is often illustrated using the Bow Tie model or the Swiss Cheese model. And these models may illustrate and distinguish between the two different types of KPIs leading and lagging indicators. While indicators are generally retrospective or outcome-based whereas leading indicators are usually forward looking and input-based.

One of the challenges in the establishment of major hazard indicators to define indicators that reflect the protection against major hazards in a realistic manner. Often from OLF's point-of-view, this will need more than one indicator. For instance, precursor-based indicators as well as barrier indicators. Therefore, lagging indicators should not be regarded or disregarded completely because they give valuable input to about how the organizations have performed in the past. It is also a way to show the organization

what is the result of unwanted occurrences. And a familiar slogan within the industry is "What is measured will be focused on."

The overall recommendation from the Norwegian perspective is it's safer to use both type of indicators if possible. The main emphasis should be on leading indicators supplemented by lagging indicators. The Norwegian petroleum industry and the individual companies use the RNNP and other safety performance indicators initiatives for different purposes such as benchmarking, experience transfer, basis for improvement projects, and safety campaigns. This figure shows the hydrocarbon leaks that have occurred on the Norwegian Continental Shelf in the same period as my colleague, Mr. Lauder, showed from the UK sector.

I'm showing you this picture because the industry have been using this picture as an incentive to initiate several industry projects with the aim to reduce the number of hydrocarbon leaks on the Norwegian Continental Shelf and started in 2000 and as you can see, we are on our way but we have still a way to go. I'd also like to point out that RNNP is an annual reporting and in order to be even more hands-on, in 2000 the industry jointly established a monthly reporting, the sum safety performance indicators as shown for hydrocarbon leaks on this chart.

The relevant safety performance indicators for major accident prevention are as previously mentioned: hydrocarbon releases, well incidents and ships or vessels on collision course. These indicators and the underlying documentation are reported on a monthly basis within the OLF as shown on this scorecard. The scorecard compares monthly results for the targets that have been set by the industry. This scorecard constitutes a permanent agenda item on every industry meeting such as the OLF's board, the OLF's operations committee and the OLF's HSE manager's forum. In addition to this, industry has for some time been working to further develop industry major risk indicators or proactive safety performance indicators and OLF therefore took an initiative and organized a workshop on the topic in December 2011. A link to these presentations is available in my detailed statement.

OLF will continuously work to identify and develop process safety performance indicators for major accident prevention, both through RNNP in corporation with the regulators and the employee representatives, from member company initiatives and through independent OLF projects. In Norway, offshore regulations are primarily performance-based and supplemented by prescriptive requirements for established norms and standards. The Norwegian regulations require compliance with the latest applicable regulations and updated reference standards. This regime focuses the operator's attention on HSE performance through self-regulation and continuous improvement. This regime is built on trust and transparency. Furthermore, collaboration between employers, unions and government as well as worker participation are important cornerstones in the efforts to establish and develop a high HSE level in the Norwegian petroleum industry. But, first and foremost, the Norwegian Petroleum Authority, the PSA, has a role as a supervisory body. The PSA is responsible for developing and enforcing regulations which govern safety and working environment in petroleum activities on the Norwegian Continental Shelf and associated land facilities.

The PSA can encourage the industry to engage in or establish improvement projects on an industry level or company level; and, thus, might represent an important promoter for HSE work. The principles of trust and transparency also plays an important role in terms of data collection where PSA can encourage voluntary participation in reporting arrangements or may by regulations require industry to report on various datasets. But PSA has the mandate and authority to manage this information in such a way that HSE information or HSE knowledge that might represent distortion of competition or that might influence

the market in any way remain anonymous. It is OLF's view that the Norwegian Petroleum Safety Authority, the PSA plays an important and central role in increasing the safety level in the Norwegian petroleum industry. I will conclude by saying that the main purpose of major hazard risk indicators is to maintain high awareness, motivation and emphasis on prevention against major accidents. OLF sees a need for further work in developing excellent process safety performance indicators for major accident prevention, both on the industrial level, cross-border, and also in corporation with other organizations such as CSB, API, OGP, and others. And OLF is positive to contribute to this kind of collaboration. Thank you.

38.1 RAFAEL MOURE-ERASO

Our next panelist is Gunhild Holter Eie. (Vice President) Statoil, also from Norway.

39 GUNHILD EIE – Statement from Statoil

Thank you, Mr. Chairman and Board Members and staff. On behalf of Statoil, I thank you for the invitation to this important public hearing. Major accident prevention must always be a top priority subject in our industry and this initiative is appreciated by Statoil. We believe that open sharing of safety knowledge including HSE results, lessons learned and tools is an important contributor to a safer operating environment. In my short introduction, I will cover three main topics. I will start by giving a short overview of Statoil. I will then go into Statoil's approach to establishing indicators for major accident prevention. Finally, I will describe Statoil's technical integrity management program team in more detail.

Part one, Statoil in brief. Statoil is an international energy company with operations in 34 countries. We have a clear technology-driven upstream strategy and had an equity production of 1.85 million barrels of oil equivalence per day in 2011. We are headquartered in Norway with 20,000 employees worldwide and are listed on the New York and Oslo stock exchanges. Our North America activities are managed out of offices in Houston, Texas, and Calgary, Alberta, Canada. Statoil North America assets represent approximately 30 percent of Statoil total discovered resources and represents an important growth area for Statoil. Our North American activities include offshore Gulf of Mexico and Canada, and onshore activities within US shale and Canadian oil sands.

The Statoil way. The way we work is as important as the goals we achieve. We believe that competitive returns for our shareholders are best achieved through a values-based performance culture, stringent ethical requirements and a code of conduct which promotes personal integrity. We set absolute requirements for health, safety and the environment and we emphasize continuous work for an improved HSE performance in all our activities.

Part two. Statoil's Approach to Indicators for Major Accident Prevention. Statoil Chief Executive Officer, Helge Lund, is very clear about safety as a top priority for the company. He states that a Major Accident is one of the most severe threats to the company’s robustness in the future. Based on our experiences and learning from past incidents, Statoil has singled out four areas of particular attention to improve our HSE performance: Leadership and compliance to our governing system; Improved risk management; Simplification and harmonization of work processes and governing systems; Increased focus on technical integrity and barriers or process safety in US terms. These focus areas have been in the headlines of our safety improvement agenda over the past five years. They have proved to be strong tools in a framework for major accident prevention.

Understanding of Risk. Statoil started out as a Norwegian state-owned company in 1972, with operations initially in Norway. The Norwegian regulations are risk-based, as we have heard, and strongly emphasize the importance of risk reduction. The operator is the responsible party and shall ensure compliance with functional requirements stipulated in health, safety and environmental legislation. Reducing the risk to the greatest extent possible is the basic principle for risk management. To understand and monitor major accident risk at a corporate level, a set of indicators are used in Statoil. The two most focused ones are serious incident frequency, which includes both accidents with serious damage or loss and incidents with serious potential which it makes it having a leading part. The other most focused one is actual gas leaks. In addition to these indicators, a set of additional monitoring reports which includes technical integrity status and benchmark reports are actively used at the corporate level.

These indicators and monitoring reports give useful input to benchmarking, learning and improvements at all levels. However, the recording of hydrocarbon leakages and other reactive event data are lagging indicators turning focus to barrier defects, events and consequences after they have occurred. Our focus is turning to better understand the underlying causes of an incident or accident, and to develop leading indicators related to quality of the critical barriers. This can enable us to act more proactively to avoid incidents.

Holistic Barrier Management. Different barriers can be of a technical, operational or organizational nature or a combination. A complete set of indicators for managing major accident risk must cover the man, technology and organization perspective. Statoil has this as our framework for developing indicators for major accident risk, and we continuously strive towards identifying, monitoring and verification tools, and indicators to address the holistic perspective. The Norwegian Petroleum Safety Authority drives focus and performance with the Risk Level Norwegian Petroleum Activities RNNP program, which has already been mentioned by my Norwegian colleagues. A considerable amount of data is collected annually and gives the industry and stakeholders access to valuable trend analysis, benchmark results and qualitative analysis. Over the last 10 years, RNNP has developed a tripartite collaboration with Authorities, companies and employees anchoring a common understanding of the risk picture. Statoil puts considerable effort into the data collection and interpretation of results. Conclusions and recommendations from RNNP are evaluated towards established activities and measures. We believe management of safety barriers requires a risk-based mindset with the following steps to be taken. First you need to do a risk analysis of the actual scenarios to identify safety barriers in the relevant chain of events. And a Bow Tie model as you see on the screen is well suited to illustrate barriers in chains of events. Next step is establish performance standards for the barriers. Next to manage barrier integrity. And, fourth, measure barrier integrity as process safety indicators.

In the extended statement posted on the CSB website, I have listed some examples of leading Statoil tools and indicators in holistic barrier management. With the time available for my presentation, I will limit myself to go more in-depth into one of them, the Technical Integrity Management Program. So, part three, the Technical Integrity Management Program, TIMP. The Statoil definition of Technical Integrity is a system or a facility's ability to function as intended and in accordance with regulations and internal provisions. Investigations of potential and actual major accidents often show that organizations experiencing major accidents and incidents were confronted with apparent symptoms of deteriorating safety critical barriers over a long period of time. Unfortunately, the symptoms were either not regarded as being alarming, or they were not treated appropriately.

The Technical Integrity Management Program contains a work process, a method for risk assessment and a tool for visualization and follow-up of technical integrity. The work process takes a bottom-up approach to establish the overview of the technical condition. The bottom-up approach. In daily operation, the operators and maintenance technicians record their activities and findings in various computerized systems. These records store lots of information that can be used to analyze the condition of equipment, systems or entire barrier functions. Typical information sources can be as you see on the bottom part of the slide: Incident reporting; backlog and safety critical maintenance; availability of safety equipment; temporary dispensations; verification reports; and test data for safety critical equipment and others. In the bottom-up approach, we start assessing condition on a detailed level based on the different information sources we have as on the bottom of the figure, and escalate from equipment via systems and barriers to a facility level. These assessments are discussed in the following.

Equipment assessment. Responsible personnel are appointed for all safety-critical equipment on a facility. These appointed experts assess the data periodically to determine the equipment's current ability to perform its function related to safety. Individual grades ranging from B, good function, to F, function failure, are given to indicate the condition of the equipment. A short statement giving the reason for the grade is also produced. System and barrier assessments. The equipment assessment is aggregated to a system level and further to a barrier level. The responsible engineers assign grades and condition statement in the same manner as for the equipment. Each barrier function has an assigned Performance Standard – or PS as you see in the Bow Tie model on the top part of the picture – that forms the basis for safety system elements performance. This shall be sustained and verified through the lifecycle of the installation.

The specific safety performance standards shall ensure that barriers are suitable and fully effective for the type of hazard identified; that they have sufficient capacity for the duration of the hazard or the required time to provide evacuation of the installation; have sufficient availability; have adequate response time; and, are suitable for all operating conditions. The performance standards assessment of the barriers shall reflect the most serious gaps and the results are presented in a Bow Tie model providing an at-a-glance status of the facility visualized using grades and colors in the Bow Tie figure as you see in the middle part of the new slide I put up.

Facility assessment. When the system and barrier assessments have been completed, a meeting takes place, where the experts participate in a facility evaluation together with operations staff. This ensures a common understanding of the safety condition of the facility, and a summary report is produced and published following this meeting. And the summary report, you can see part of it on the topside of the figure. Priorities and mitigating measures are decided and implemented to compensate for sub-standard conditions.

Our TIMP experiences so far. Nearly two years into the Technical Integrity Management Program, our experience is that even if the workload on our experts may have increased somewhat, the understanding and awareness of barrier functions have increased significantly, and the facility is able to prioritize its efforts better, both with respect to safety and productivity. TIMP is a new way of working with leading indicators. The process with aggregation of information, combined with expert judgment, is in itself an important strengthening of safety culture and awareness. The TIMP portal, as you see on the screen, visualizes the technical status of the facility as a leading indicator. The information is transparent and well documented. TIMP also facilitates experience transfer and knowledge transfer across technical disciplines and facilities. Together, these elements make TIMP a powerful tool.

These two days, each participant brings their own set of experiences and practices to the table. My hope for these two days is that the exchange of knowledge, information and experience will produce mutual learning and improvements to help us meet the ultimate objective – safe and reliable operations. Thank you for listening.

39.1 RAFAEL MOURE-ERASO

Thank you very much. Next and last speaker is Joe Stough, Vice president of Innocation Technologies (INAUDIBLE)

40 JOE STOUGH – Overview of Leading Indicator Research and Usage

Hi. And, first off, I want to thank the CSB for the invitation to speak and for the distinguished opportunity to be the last speaker on the last day after two very long and productive days. But I guess more importantly, I also want to thank you for putting on such an event. It's been very enlightening and there has been some very interesting discussion and just being here is also a great privilege.

In my presentation, I'll talk about a leading indicator research and benchmarking program that we've undertaken for the last several years and what I'll cover over the next 15 minutes is first a description of the desired outcome from that research and then I'll give you a description of the premise, the data that we use for the research, the findings, the results of our research and then some examples of applications for, practical applications for our findings.

Before I start, I wanted to make a couple of comments. First, there's been over the past two days, a lot of discussion, interesting discussion and presentations about safety barriers, safety systems, barrier effectiveness and how what to measure in terms of measuring technical integrity and so on. What I wanted to say going into my presentation is that the focus of our work has really been on the organizational factors that underlie an operating asset's capability to sustain excellence in their barriers or to sustain a minimum level of gaps in their safety systems or barriers. So I wanted to make the distinction that our work, as you'll see, is more focused on the organizational factors. So, over the past few years, we've been involved with a group of some of the largest global energy companies in the world that I really do believe have the intent to cure their leadership addiction for lagging indicators. I feel fairly comfortable after really spending quite a bit of time over the last few years, really just about the bulk of the last 20 years focused on this issue to say that industry is largely addicted to lagging indicators in the way that they measure safety, whether it's personnel safety or process safety.

Lagging indicators as you move further up the corporation in our experience really rule the day, especially when you get closer to the CEO. But I'll end by saying that in some of the recent conversations that we've had with CEOs and COOs in the energy industry, I've been pleasantly surprised at how in tune they are to even the granularity of the types of investigation processes and even the semantics around safety and process safety. So, I'll say that in my opinion, there's been a nice increase in the executives getting it. So, I'll move on.

The desired outcome from our research program is to apply years of data collection of a really large dataset that I'll explain shortly and mathematical methods, statistical methods to identify leading indicators for practical use. So, from the beginning, our intent was to identify leading indicators that could be applied practically by operating leadership. And when I say operating leadership, I'm talking about from a unit superintendent, front line supervisor all the way up to the CEO. And I really do mean all the way up to the CEO of a corporation. So, applied by leadership to drive performance results, essentially to enable a continuous improvement process. So, the two practical applications that we've worked toward, one is benchmarking. So, calculation of normalize leading indicators that are statistically validated that allow comparisons across companies, really across the operating assets within the companies that we're working with.

And then the second practical application is the use of these types of measurements as operating metrics for routinely measuring performance within the business operations. With those desired outcomes as a backdrop, what I've listed here are the criteria that we've used for determining the definition and

selection of the leading metrics that we deemed after several years of research were the most meaningful and practically useful.

First is routinely measurable. So, a leading indicator to meet our desired outcomes and objectives listed above needed to be a measurement that changed routinely as opposed to, for example, a corporate management system audit that happens once a year and provides a score or feedback on leading performance but only changes once a year. We were really looking for metrics that changed on a routine basis at least monthly so that they could be used out in the field. Practically actionable, so something that once an undesirable score is discovered for a manager in a particular leading metric area, the manager could turn around and do something about it.

Objective, so what I'll describe our objective criteria as an example is a measurement drawn from the detailed activity from the workforce as opposed to a subjective opinion from a survey or an assessment. So, actually drawing a calculation from data that comes from real activities that are happening in the field as opposed to someone's opinion about those activities. Normalized, that's been discussed multiple times but obviously we need normalized both so that we can have the benchmarking comparisons across operating assets, across companies; but also normalized allows us to have a better interpretation of a measurement. You know, whether high really is high, low really is low and so on.

Predictive. So, this final piece, I left it as last but it's probably the most critical is that the measurements that we choose are proven to actually effect the outcome that we desire. So, we desire to effect the outcome of loss events, of safety or process safety performance. So we're looking for measurements that actually are proven mathematically or scientifically to have the desired effect. Those are the criteria. A little about the premise of our research program. As I mentioned, we've worked with a number of the world's largest energy companies on a global scale, so the dataset that we've collected covers thousands of operating assets over a hundred countries. Most of the energy industry super majors are involved in the program voluntarily, obviously. And it covers all of their asset types, so not just offshore production assets but also refineries, chemical plants, pipelines, all the way even to their supply and trading and retail and so on.

And we have a number of asset types even outside of energy and chemicals manufacturing. The dataset includes millions of assessment records, observations, surveys, hazard IDs, inspections, near-miss reports, meetings, miscellaneous safety suggestions and so on, other types of proactive activities. And, in addition, includes over a million incidents. So, by looking at the incident data, we are able to observe that there were a number of operating assets that are able to sustain performance near zero. And I'll explain "zero" in a second.

And, on the other end of the spectrum, operating assets roughly in the same operating environment, the same types of risk, and even in some cases, in the same types of companies that are operating orders of magnitude worse. And, so, just to give you a little context to the word, to the number zero that I'm referring to here, when I refer to zero here, I'm not talking about zero as a frequency rate but zero as a severity-weighted incident rate. So we felt that the best way to measure performance in a normalized way cutting across the different types of assets and different companies we were working with was to provide essentially an index, a lagging index as the measure that we were intending to predict. And the index that we created entailed providing weights to the incidents to give us a sense of a severity and frequency of incidence within an operating asset.

So, what we were looking for was to differentiate if an organization or an operating asset were to show up on the left side of this bell curve in the best performing assets, we wanted to make sure that they not only had a low frequency but also low severity of incidents over time and that they were able to sustain that performance. So the question that our research intended to ask is what are the actionable, measurable differences that lead to these results. What is it that makes the best performing asset so much better than the worst, what are the factors again that meet the criteria we mentioned earlier, criteria as being used as management controls and for benchmarking that lead to these results.

Our hypothesis behind the research was essentially that organizations which are the best at identifying and resolving gaps in their safety systems or barriers will have the best performance, the best severity-weighted lost performance. And, so, with that as our hypothesis, what I'll describe on this slide is the data that we used to test that hypothesis and then eventually drove our analytics to find leading indicators.

First are the set of the types of activities that you might see within an operating asset that entail at the end of the day the discovery of a gap in a barrier or a safety system and it could come from something as formal as a process hazard analysis or a risk assessment or maybe a JHA or a task risk assessment, or it may come from something as casual as a safety suggestion, it could come from a near miss. So, are examples of activities that are reported on a daily basis or at least a routine basis in the field that entailed the discovery of gaps in safety systems.

And, so, we were observing these types of activities, the rate of these activities, who is conducting them and so on. But I think more importantly what we were able to observe is the organizational treatment of these activities. So the process behind the occurrence of a near-miss event, the reporting of a finding from a PHA or an audit, who is getting involved in these activities, are they getting involved promptly, are they disciplined in carrying out these processes. The types of things we measured, for example, if you had a near-miss, we're measuring the mean time between the occurrence of a near-miss and the response by the organization to that near-miss, so, the mean time between the data and time the near-miss occurred to the point that either a supervisor or maybe a safety professional – whoever the organization assigns in their business process has responded to take that near-miss and process it.

And we're also measuring behind that processes like risk matrices that are assigned to near-misses to provide a risk score or maybe a probability or even a severity score, a potential severity score on near-misses, who is conducting those types of assessments, are leaders getting involved in these stages or is it just being done by safety experts. Those are the types of questions that we're asking of the data. And then behind those activities, the final step in these processes are the action items. I mentioned we're measuring an organization's capability at identifying and resolving or reducing gaps in safety systems. The action item execution piece is where the reduction of gaps occurs. So we're looking at not just the implementation of action items, but even the authorization of action items by leadership. Are leaders getting involved promptly to review and authorize these actions so that then the action items and action plans can be assigned to the field or are they taking a long time to do so.

And then we're measuring action item completion and dissemination of lessons learned and so on. Quickly, the process we followed in 2008, we had accumulated enough data to do this analysis, so we started by bringing together the group of companies that participated to do metric brainstorming. We identified over 200 potential leading metrics in 2008. In 2009 and 2010, we started gathering datasets and applied statistical analysis to reduce the list to roughly 70 of the most meaningful metrics. Then in 2011, we went around to each of the member companies, calculated these metrics through an index that I'll

describe on the next slide and calculated benchmarks on that index for each of the operating assets for the participating companies to provide them with feedback and where they had gaps and issues.

But in late 2010 and early 2011, we found a single index that was both the most predictive of safety performance and was the most practical for use as a management KPI. And, so, this next slide describes the components of that index. The index is broken into three major pieces. The first piece is measuring reporting culture and that's a combination of the volume of reporting, so that gets to the engagement of workers, an issue that's been raised several times over the last couple of days. It gets to the engagement of workers, the proactive involvement of the workforce in measuring the volume of reporting. But the reporting culture index in and of itself is not just a measure of the volume of reporting but also the follow-up. Just to clarify, as we used these metrics and ran them thorough our statistical process, we didn't have a premonition as to how the metrics should fit together. The statistics came out and told us what metrics fit together. Then we spent time with the group of subject matter experts from the industry companies and received feedback to interpret how the metrics should be used and if they were practical for use on scorecards.

Reporting culture included both the volume of reporting and the rate of follow-up behind reported events. Those two things together make up the index for reporting culture. Action execution included both the rate of proactive action and timely completion; so, disciplined completion of those actions. And then the leadership responsiveness was the third measure.

I'll move forward. But we took these three index components and the overarching index and calculated quartile scorecards to produce the benchmarking. One of practical application of the research was to produce the benchmarks that are shared across companies. What this next slide will share is the other application that alluded to earlier and that's the use of these insights from the research to help organizations determine what they should measure, where they have issues and what they should measure, again in terms of the organizational factors that we found to be most predictive of performance. So, one thing that we have discovered through several years of providing our insights from our research to companies that have attempted to transform their lagging indicator addiction and start using leading indicators is that you really need two parallel measurement initiatives.

One that out in the field is addressing metrics that are more transparent, more directly relevant to the field level line managers, easier for them to use, maybe even in some cases, not normalized maybe because they're not ready for normalized metrics in a particular asset, but it provides a measurement of an issue like reporting culture, action execution of issues that we found in a manner that's acceptable that they're ready to use. So, there's a line manager scorecard that's looked at on a monthly basis; it's more granular, it's out in the field, but it addresses the issues that are found at a more macro level with the indices that are looked at typically only by the executive team. And, so, here what we were attempting to do and what we're working with these organizations to do now is to transform the focus on days away from work rate metrics and other lagging metrics that the last couple of days have been slammed into the turf; so they're clearly not the future. But to start transforming attention of senior leaders to look at something that's validated that they believe in. And the term that I mention at the bottom here, "Operative value aligned," what I intend to communicate with that is an operative value is a value that's reflected by the leaders of the organization in where they put their money, their resources, their time as opposed to what they say their values are. Operative value aligned, for example, one of the companies we work with spends a lot of time and money on their operational excellence management system, what they call their "critical six processes."

They have a process sponsor for each process and the process sponsors are presidents of the operating units. I mean these are presidents of 20 billion US dollar per year divisions of the company that are the process sponsor. They also have a process network with process advisors and experts. And, so, they spend a lot of time and money, so we felt that their operative value was around the execution of these processes; in identifying metrics that aligned with process execution, you're metrics that are operative value aligned for that organization. So, we felt that was- we found that to be a key to get senior leaders' buy-in to transforming their focus towards leading indicators. Okay, that wraps it up. Thank you.

41 Questions and Answers by Board, Staff and Public

41.1.1 JOHN BRESLAND

This isn't really a question but I have a comment for Mr. Lauder. I received a copy of the Press and Journal. Is that your local newspaper?

41.1.2 BOB LAUDER

Yeah, it claims to be.

41.1.3 JOHN BRESLAND

Well, my brother-in-law sent it to me – or my ex-brother-in-law sent it to me and he didn't send it to me because of the report about Oil and Gas UK but more about Donald Trump (INAUDIBLE) his new golf course.

41.1.4 BOB LAUDER

Okay, yeah, yeah.

41.1.5 JOHN BRESLAND

(INAUDIBLE) So I was reading through it and here, lo and behold, I see an article about – it's a good article about -

41.1.6 BOB LAUDER

There's a first time for everything.

41.1.7 JOHN BRESLAND

Your first safety report.

41.1.8 BOB LAUDER

Oh, yeah, sure.

41.1.9 JOHN BRESLAND

Yeah and it says good things about it and it's really, so it was interesting. I was reading this last week and I didn't really expect to find to be in contact with the person who was actually involved in collecting this information. Is this typical of the sort of transparency that you have?

41.1.10 BOB LAUDER

I think it's helpful, I think certainly the transparency has maybe shifted in some way the relationship with the media. I think that's something you could easily say. Certainly, journalists don't like

to try too hard for the story, so if you can give them a good news story, they'll take it, yeah. I wish I had seen that, I think I missed that article, actually.

41.1.11 JOHN BRESLAND

I'll sell it to you. A question for – is it doctor, mister -

41.1.12 JOE STOUGH

Mister.

41.1.13 JOHN BRESLAND

Okay. The practical application and the very last slide you had, is that based on actual numbers for a particular company?

41.1.14 JOE STOUGH

That's correct, yes.

41.1.15 JOHN BRESLAND

I didn't understand – one of the numbers here was on in the executive leader process and the good- the good were low numbers.

41.1.16 JOE STOUGH

Yes, in that case, you'd be measuring responsiveness. As an example. To be clear, those were just examples.

41.1.17 JOHN BRESLAND

So the faster the responsiveness, the lower the number would be?

41.1.18 JOE STOUGH

Correct. Yes.

41.1.19 JOHN BRESLAND

So that leadership when they're looking at that would be able to tell quickly.

41.1.20 JOE STOUGH

Yeah, more responsive involvement, for example, in things like authorizing the action items from an investigation report. And leaders, typically, leaders are required to authorized that an action will be considered by the organization and then executed. And we're measuring that involvement of leadership in that step.

41.1.21 JOHN BRESLAND

Did companies supply the data to you because it seems like a huge amount of work that went into doing this.

41.1.22 JOE STOUGH

That's correct. Well, all of the companies were using a common software platform for managing all of those processes, so it made it a little easier to get to all of this data.

41.1.23 JOHN BRESLAND

Okay. I may have some more questions later but-

41.1.24 RAFAEL MOURE-ERASO

I also remind our CSB people here that Mr. Wilkinson is also part of this panel, so if you have questions for him. So, Member Griffon, please.

41.1.25 MARK GRIFFON

Yeah, I just wanted to follow-up with a question for Oil and Gas UK and then maybe for the entire panel I think the other questions are for. But you mentioned in your presentation that it was a big deal to have the transparency that you have and I just wanted to follow-up. I think John sort of touched on this but can you share with us a little more on that? How did it happen and do you think it actually is improving or improving safety, process safety?

41.1.26 BOB LAUDER

Yeah, to kind of throw in history a little bit, I think it's almost a human trait, isn't it, not to be putting your dirty laundry into the public domain if you like. So there is a default behavior I think in many people not to be putting the bad news out there because most times, it will be interpreted as bad news, that's for sure. So, in that particular issue that we're talking about there, i.e., the naming of the duty-holders who were having gas releases and what have you, that's always been – we've always known having the gas releases we were having, we've always known what the severity of those gas releases were. And, really, the tipping point in terms of the disclosure was actually two, one of which I probably don't have to tell you but I will share with you just in a second. But one of the tipping points was the targeted reduction effort that we are now meeting. And there was a realization that there are good performers out there and there are less than good performers. But we actually didn't know who they were, the regulator because they manage the data, but the industry didn't know. So, we couldn't get into kind of experience sharing and kind of helping each other up the path, if you like. So, that was one of the issues was that the leadership teams in the industry, Step Change leadership team in particular, thought that it would be beneficial to know who the good guys were and maybe the not-so-good guys and we can do more sharing.

The other slightly more – how best to put it – uncharitable approach or less altruistic approach was that that information is actually getable. We have in the UK a freedom of information act. So if you're a mischievous journalist and you want to make mischief, you can go to the regulator and you can request that data and you can write a story around it and you can make that story as bad as you want it to be. And we actually did experience that last year with one particular journalist who got close on three years' worth

of data, much of which was not good and he focused on the not good and we finished a splash article very different from the shiny one that you very kindly showed us a minute ago.

So I think there was then a realization if you get it, why don't we just give it. And that has actually had an effect that the sting has kind of been taken out of the story because it's out there, they don't have to go digging. And, essentially, we think it's the right thing to do. But it didn't – as I said, it did not happen overnight and it didn't happen without resistance. Is that okay?

41.1.27 MARK GRIFFON

Yeah. And then the next question I have, I think in some way or another, I think it applies to everyone on the panel. So – and I'm sort of stealing a question from yesterday because I thought it was a very good question. And as Peter pointed out, we've hashed over a lot of things again and again. But the question – and you mentioned that Mr. Stough, your presentation on the baseline but the question yesterday was how do you determine what normal is. And I guess this gets into the question of how do you set your baseline metrics, how do you – and then I guess one step beyond that particularly in the offshore sector where you're dealing with more expanding circumstances – I guess deeper wells, different-different geological conditions, how do you determine what your, what normal is. And then have any of you in the brief histories modified your metrics, have you changed that.

41.1.28 GUNHILD EIE

Yes. I can give a very specific example. Safety critical equipment have been mentioned in several occasions. And in Norway we have for several years have sort of informal collaboration between operators on establishing maximum failure rates for safety critical equipment. We meant that they had to have a certain degree of availability and agreed on criteria that we have implemented in Norway. And they are actually now being implemented into the RNNP process as well as tolerance criteria for safety critical equipment. So, that's sort of one very specific example on defining a level of normal or at least best practices and maybe an even better – or tolerance criteria.

41.1.29 MARK GRIFFON

Very interesting. Yes, anyone else want to -

41.1.30 AUD NISTOV

I could add something to that. The RNNP report has introduced normalization (INAUDIBLE) man hours, the number of installation years and number of well drills, number of helicopter flights per installation or person flight hours and so on and so on. And we also tried to look into if we could have normalization for the complexity of each installation because some are, as mentioned previously today, they are not simple but they are manageable. And some are very, very complex installations at least in the North Sea. So and then we looked into think number of lead sources give us more information. And we have recently just finalized a project on hydrocarbon leak reduction project. That's the third or fourth project we have. And we are looking into the leaks occurring in the last four-year period. And where we normalized the information we had against installation leak frequency number of leak sources and number operation or work permits, if you may. And that study gave us quite a bit of new information regarding root causes to the hydrocarbon leaks. It hasn't changed anything reporting yet but I think the information gained and trying to look into ways of normalizing data is very valuable. Thank you.

41.1.31 CHARLIE WILLIAMS

I was just going to say I think also we thought about this, we don't have the baby yet, so we don't have any way to set the baseline. But, for instance, thinking about kicks, there was a lot of discussion about kicks and one of the considerations we have is there is a kick where you do not respond to the kick in a sufficient amount of time. So you could set a criteria that set a certain pressure or certain volume as a kick that wasn't properly responded to. And then you can have, of course, kicks that were properly responded to, you know what you have are less than that. But you'd likely want to try both. Even though you'd say the ones that have a proper response or acceptable, it would still be good to know the frequency so you'd know what the exposure level was, even though it wasn't a threat like one that was unresponded to. So, I think there's going to be different baselines for different purposes.

41.1.32 MARK GRIFFON

Thank you.

41.1.33 JOE STOUGH

Well, I wanted to just add to that. With each metric, what we've done in our research is first each of the metrics by nature have to be normalize, so we're looking at mostly percentages, rates, ratios, averages, things that enable apples to apples comparison. So we look at that as a criteria for the definition of the metric and then the second thing we look at is does it have an effect on performance. So, in order to determine what normal or what the baseline or what average is, we first look at whether the metric has an effect on performance. And that led us to reducing our number of metrics based on statistical analysis. And then we look at, well, what kind of effect does it have. So, in the example that came up earlier, it was actually a negative effect. You know as the measure went down, performance got better because in that case, we were talking about the mean time to response of a leader.

You know if you're talking about maybe a reporting rate, a reporting culture rate, then it's maybe a positive effect. So, we look at both the fact that the measure is normalized and the directional effect and then we can determine thresholds of performance. So, you might have a near-miss reporting rate of 17, which really doesn't mean anything by itself. But by having a good enough dataset to be able to tell that 17 is average or maybe 17 is top quartile, then that gives you a sense of what's normal or not.

41.1.34 MARK GRIFFON

I think I'll just follow up one more with Mr. Stough. I think the dataset you have is very intriguing and I'm not going to explore it here but I'm very interested in it. But, I mean it sort of gets at my question as to whether you select the average as your normal or your baseline or if you pick the five percentile or the 25th percentile, you know so you're challenging the sector to you know don't just accept the average value but-

41.1.35 JOE STOUGH

You mean the target.

41.1.36 MARK GRIFFON

Push harder in lower targets and anything above that would be sort of a – you know pushing yourself so the baseline lower.

41.1.37 JOE STOUGH

Well, if I could make just a quick comment. It's not directly related but on an asset-by-asset basis, we would actually recommend that companies select targets that are achievable for the current state of maturity of that asset. So, if they're at quartile four in a reporting culture index, setting a target of being top five percentile is probably not achievable. You know they want – quartile four is probably pretty bad. They have some pretty big holes to fill and just filling those holes are maybe an acceptable objective for 2013. So, my point is it may be relative to the maturity level or the state of the organization.

41.1.38 MARK GRIFFON

Thank you. Very interesting.

41.1.39 RAFAEL MOURE-ERASO

Thank you. I have a question for Mr. Lauder. In your description of a major hazard management process, you have as the last step an independent competent person verification process. And I am curious about who are these people, who are these independent competent persons and how they're identified and chosen and so on.

41.1.40 BOB LAUDER

Okay, their independence comes from the fact that they do work for companies other than – sorry. They are employed by companies other than the duty-holder or the operator whose scheme they are-

41.1.41 RAFAEL MOURE-ERASO

Norwegian engineers, for example.

41.1.42 BOB LAUDER

Say again, sorry.

41.1.43 RAFAEL MOURE-ERASO

Norwegian engineers.

41.1.44 BOB LAUDER

They could be if they worked for B&B, they most likely are Norwegian engineers. But as I said, they independence says that they work for a company such as Lloyd's, DNV, Bureau of ____, ABS, etc., etc. They are very niche part of the employment market almost. They're technically competent, they're normally (INAUDIBLE) of engineers in their specific discipline. So people looking at structure or process equipment, hydrocarbon containment equipment, etc. They're very, very focused on that. So, they are outside of the operating company whose scheme they are verifying.

41.1.45 RAFAEL MOURE-ERASO

And also your reporting of KPI, ones and twos and threes. I wonder if you make a difference between – if this data come from drilling or production or drilling and production together.

41.1.46 BOB LAUDER

If it's on a platform, it comes from all parts of the platform, a production platform. We don't do the ____ fleets, we don't do the mobile fleets at all at the moment. So, an exploration well will not feature in that dataset.

41.1.47 RAFAEL MOURE-ERASO

Thank you.

41.1.48 BOB LAUDER

Sorry. Let me correct myself. If it had a gas release, it would be in KPI-1, hydrocarbon release, it would be in KPI-1. In fact, the graphic I had were the name organizations that were I think I recall some drilling operators on there, yeah, rig operators, yeah. But the verification side and the safety critical maintenance is installation based, fixed installation, floaters, but not the rig market.

41.1.49 RAFAEL MOURE-ERASO

Thank you. The next question I have is for Mr. Williams. I understand that API is actively developing, working with your center in developing indexes and indicators. And I was wondering that given the problems that we have in the past, getting a representatives or stakeholders in developing this, how the different stakeholders are going to be involved in the development of these indicators. How have you (INAUDIBLE)

41.1.50 CHARLIE WILLIAMS

You know actually that works really being done you know entirely within the COS organization but there's 40 people involved right now in that ___ group and it's people from contractors, from operators, from service companies. BSEE is participating and the Coast Guard is participating. So we're – anybody that's a stakeholder that has expertise that's interested and wants to contribute has been coming to the meetings to work on indicators. So, that's the way we're doing it now.

41.1.51 RAFAEL MOURE-ERASO

Also you of course are designing this for the company (INAUDIBLE) but you are also developing indicators for drillers and cementers or others involved in the process or it's just the lessee.

41.1.52 CHARLIE WILLIAMS

That's correct. It's for everybody. In fact, it includes a Marine as well. So, since we have the contractors there, they're divided up into different groups, they're actually in different parts of it. But they're each one looking at the bow ties for their major activity and looking at the barriers in those bow ties and then building safety performance indicators related to those barriers. So, we're doing for all facets of the business, even through a Marine.

41.1.53 RAFAEL MOURE-ERASO

And are these APIs entered in (INAUDIBLE) data going to be shared with the public or this is going to be private data.

41.1.54 CHARLIE WILLIAMS

Well, we haven't decided yet because we haven't even defined the indicators how the sharing would be. But I mean – excuse me – but I mean the indicators themselves, you know what they are and what we're learning from them is going to be available.

41.1.55 RAFAEL MOURE-ERASO

To Dr. Nistov, I have a question. In your incident report on Deepwater that you shared with us here, you identified a specific potential in this – or indicator – that you call company maintenance backlog as one of the things that the study of that will be a leading indicator. And I was wondering how do you make the decision that this is a predictive leading indicator or how that conclusion was arrived at by OLF.

41.1.56 AUD NISTOV

I think it's fair to say that we haven't decided that this will be a leading performing indicator. But it has been proposed as something that we need to look into. And it was proposed because several of our member companies have been looking into their own maintenance backlog and was considering whether to – or had started to sue this as an indicator. At the same time, I'm perfectly aware that from an academic point-of-view, it's difficult to track the correlation between the backlog maintenance indicator and the prevention of accident. So, we haven't a strong relation that that has been proven yet. But I think a maintenance backlog is something that provides very, very important information, perhaps together with other precursors or leading indicators. So I think that is a way we will proceed from the OLF's point-of-view.

41.1.57 RAFAEL MOURE-ERASO

Thank you. To Miss Eie from Statoil. I wonder, I mean I understand the system on Norway that has three partite systems in which they are workers and government and industry involved. But in your particular company, what – do you have any specific methods to make your workers and your unions to participate in the processes of developing indicators?

41.1.58 GUNHILD EIE

Yes, we have as was mentioned by the SAFE representative, Mr. Furre earlier. The working environment committees which are very important collaborative meetings or groups in each part of the company. They are a requirement to have a working environment committee in each part of the company in Norway. And, all issues regarding HSE shall be treated in that meeting. And that could be, for example, it would be natural to discuss there which targets should we have on our KPIs next year in those kind of meetings, both to involve their expertise and their viewpoint in setting the goals but also to ensure a common ground and common ownership of the goals that we set. I would say that probably professionals within the HSE area will propose new indicators in many ways but I think many of the ideas of how to work with the challenges that we have with HSE comes also from the union representatives. And in that

perspective, I think we to get a common understanding of the risks that the company is exposed to and that forms the basis for which indicators we will address to focus on our major risks will come from both a management or a professional and employee representative point-of-view.

41.1.59 RAFAEL MOURE-ERASO

Thank you. And my last question is to Mr. Stough. When you were talking about best performing organizations and you said that a predictive index will be defined the reporting culture, the action execution and then the leadership responsiveness. And it seems that for reporting culture and action execution, there were sort of quantitative, measurable things. But when you talk about little responsiveness, you will say there will be decision making if the leadership was responsive. And it seems – is that also a quantitative measurement, how do you decide if the leadership is responsive or not?

41.1.60 JOE STOUGH

The answer is yes. It is quantitative. We just interpreted the last component of our index to be measuring leadership responsiveness. And one of the earlier questions that Mr. Bresland asked pertaining to an example number that I had one of the slides that seemed to be low was better and high looked worse, pertaining to – that example measurement pertained to measuring the responsiveness of leaders in the overall action item process. And, so, that's a quantifiable measure where we're cutting across the different types of action items that are managed within an asset and measuring the time it takes for leaders to authorize those actions to take them from the action has been defined and contemplated to the action is actually being implemented in that transition. So, we're measuring basically the mean number of days. And, to be clear, that's just one metric within the index and it's just an example.

41.1.61 RAFAEL MOURE-ERASO

Okay, thank you. I would like to ask the staff panelists to ask questions, please.

41.1.62 DONALD HOLMSTROM

I have a couple of questions. My first one is to Mr. Williams. I really want to thank – it was a privilege to have all of you here today. Thank you very much for coming. (This has been) a great experience. My first question is to Mr. Williams. What is the outcome of this indicators work that you're doing? Is the Center for Offshore Safety, are you going to be in the standards business, is that going to be deferred to API, is API developing a standard on offshore safety indicators? What is the outcome there?

41.1.63 CHARLIE WILLIAMS

Right now, we're planning to create a document in COS on safety performance indicators. That's the way it's going to be done. But as we gain the data and find all the safety performance indicators admit to be indicative of problems in your SEMS process. So, as we find those, we'll determine what the gaps are. And then when we close the gaps, it will be two ways; one way would be we'd do it in COS by developing a good practice, but if we needed to develop a standard or a recommended practice or make changes to those, those would be referred through the API process.

41.1.64 DONALD HOLMSTROM

Thank you very much. The next question is for Mr. Lauder. There's been discussion in previous panels about the use of leading indicators and whether or not it's difficult to do comparisons across companies or industries. And how difficult is it to use leading indicators and do you have a leading indicator that is related to safety critical maintenance backlog. And, so, my question is obviously you did some work to kind of communicate how to derive and report a particular number, and did you find that to be an insurmountable problem or is it something that were able resolve.

41.1.65 BOB LAUDER

In actual fact, it's relatively easy if I can make so bold. And the reason it is so is because it's very much linked to regulatory obligation to maintain your safety critical elements in good condition. So, everybody has to do that. Everybody scrutinized to make sure they are doing it. There are some little variations, if you like, in people's approaches to maintenance, but none of those are problematic in terms of looking for alignment in KPIs at all. And, I mentioned the switch from straightforward man-hours to percentage completion approach and that was to smooth out some of the variations. And, I'll very briefly describe one to you that when we went looking at how people were actually managing this, we did a bit of a walk around some of the duty-holders and saw how they were creating the data and managing maintenance.

And one obvious variation which did have an effect on accumulated man hours was that if you take a gas head sitting high up in a production module, one operator would count only the contact hours with that gas head, i.e., the technician's contact with the gas head to make sure it's in collaboration, another operator might include in their man hours the scaffolding, the access to that gas head. So you could have a 50-hour job or a 2-hour job; they're actually the same job but the man-hour contribution is significantly variable. So, going for percentage completion actually smooths that out.

41.1.66 DONALD HOLMSTROM

Thank you very much. My next question is for Miss Eie. And you talked about the TIMP model and that was very interesting. And one of the elements you talked about was that you looked at was barrier availability. And one question I have is how do you determine that. You know, there's been a move across coming out of the process safety world and onshore installations. There used to be a world where people used to put forward that operator action and alarms were the typical safeguards that you would have. And there has been a movement with layers of protection analysis and safety instrumented systems where people are actually doing more work on what the actual availability to these barriers are and assigning a safety integrity level and determining an actual high percentage if it's safety critical for availability. Do you apply those concepts to barrier availability for offshore protection?

41.1.67 GUNHILD EIE

Thank you for the question. We don't usually use the term “barrier availability” but we have performance standards for barriers. So, we measure our barriers against performance standards. And one of the input parameters to assess the integrity of the barrier is availability of safety systems. And that could be based on test data for the safety critical equipment, that could be based on whether safety systems are taken out of service for a period or not. So, this availability of safety systems is sort of one input parameter to analysis of the barrier with respect to its performance standard. So, typically, our performance standards for the safety systems and barriers are (impacted) by several function requirements related both to the

(INAUDIBLE) aspects, to reliability aspects, to survivability aspects and to that documentation shall be in order and fully up-to-date. And also related to operational aspects of how the barrier is operated by the operating organization.

41.1.68 DONALD HOLMSTROM

Thank you.

41.1.69 BOB LAUDER

I have a couple questions for Mr. Williams. And, Mr. Williams, I hope – please don't take these questions personally. They're not intended in a personal way. You know the term "independence" I think is a very important one and I think many of us will agree. For example, in drilling operations effective barriers need to be independent of other barriers to be truly effective. In another example, perhaps one of the key learnings of the Piper Alpha disaster is that an effective regulator needs to be a truly independent regulator because at the time of Piper Alpha, the regulator is in charge of promoting the industry as well as safety management of the industry. And it was changed afterwards. So, independence I think is very important. In fact, for the Chemical Safety Board, our most important attribute is our independence. So, the Committee on Offshore Safety is described as independent. Help me understand that better. How is the organization funded?

41.1.70 CHARLIE WILLIAMS

It's funded by the contributions from the members.

41.1.71 BOB LAUDER

And the members are?

41.1.72 CHARLIE WILLIAMS

The Center of Offshore Safety, which is would be operators, contractors, service companies that choose to join.

41.1.73 BOB LAUDER

Okay. And am I correct in understanding that the chairman of the Committee on Offshore Safety is selected by API?

41.1.74 CHARLIE WILLIAMS

That's correct.

41.1.75 BOB LAUDER

Thank you. Mr. Stough, I have -

41.1.76 CHARLIE WILLIAMS

Well, as part of – I mean part of the selection process, I mean there's a series of recommendations and final approvals.

41.1.77 BOB LAUDER

Thank you very much. Thank you. Mr. Stough, you shared with us a really immense volume of work about indicators. And it seems to me that it would be very valuable for that to be widely shared and to have some form of public availability so that others could learn from that. What are your plans along those lines?

41.1.78 JOE STOUGH

Okay, to this point, a good bit of our work has been published through technical journals, technical publications in support of papers for conferences like the SPE, Society of Petroleum Engineers' conference. The latest paper was produced within the last couple of weeks in support of the SPE International conference in Australia. Also the IADC conference, ASSE. Organizations like that that we participate in from time to time. So, we've produced materials and published them through those venues. At this point, the work that we're doing is a research forum including the group of companies we've worked with to date, and you know new companies coming on from time to time. And we're publishing the real details of that work just within the confines that forum. The insights that we write in articles and papers and technical journals is the only venue we have to the public at this point.

41.1.79 BOB LAUDER

Thank you.

41.1.80 RAFAEL MOURE-ERASO

If there are no more questions from the staff -

41.1.81 KELY WILSON

I do have a question. Reflecting on this morning's provocative descriptions from Mr. Molloy and Mr. Furre on how data collection can go awry when there's company pressures or different kinds of pressures, I'm wondering primarily from Mr. Stough but others who maybe have ideas on this, how data should be collected, why the method for collection of data is important and how gaming of the data can be prevented.

41.1.82 JOE STOUGH

Interesting. I'll respond from I feel a rather narrow perspective as it compares to the broader perspectives of considering data collection for the public, public viewing and so on, you know the data collection that we prefer is collecting data straight from the heart of the operations, as opposed to data that's either been cleansed or subjectively collected maybe at a site level and then passed up to a corporate level and then passed from corporation to corporation. So, we prefer to get data straight from the detailed activities, you know the operating databases and systems that a company is using internally. So, as it pertains to reporting externally, I wouldn't have a lot of perspective on that since most of my work is done inside the walls of the companies that we work with.

41.1.83 BOB LAUDER

I might want to offer a view given that Jake Molloy offered an opinion this morning I guess. A point I want to make and probably the most susceptible indicator that we have to that form and manipulation would be the backlog man-hours. That would be the one that people might want to play with because it's kind of a contentious area. And my point there would be that there are layers of protection we believe in making sure that those numbers are safeguarded. And at its most basic level, the guys who have control over the tasks that make up the man-hours are in fact at a workforce level; and, so, they're the guys who record the fact that a task was either done or not done. Okay, so, that's right back at the origin of that data. So, we don't think there's any mileage in those guys manipulating the figures and I'm sure Jake would agree with me on that one. Hopefully he would. And, then when you come up through the chain, if you like, to getting the data to Oil and Gas UK to publish as we do, again, those are a regulatory intervention opportunity there because the ICP is scrutinizing the duty-holder's maintenance activity and its control of backlog hours. And the regulator, the Health and Safety Executive then carry out some kind of surveillance or inspection activity on the whole aspect of safety critical maintenance.

41.1.84 DONALD HOLMSTROM

One additional question for Mr. Lauder. You know there's been discussions about whether data is too infrequent to be useful and you have for example you have several indicators from the three key programs that you've developed. Can you give us a sense of kind of the datasets that you're working with? For example, one is hydrocarbon releases, kind of the general numbers we're looking at.

41.1.85 BOB LAUDER

Well, the three high-level indicators are the ones that we've been looking at today, the hydrocarbon releases is lagging and the two leading that I gave you there. Sitting behind that, there's a whole raft of other datasets relating to other dangerous occurrences that certainly have a major hazard association. So, we could tell you how many well kicks we've had for example in any given period because, again, there is a regulatory requirement to be capturing those kind of reports. So, all that stuff is around, is sitting there. You know, the focus of this event and the focus of my delivery to this event was on those three indicators. What I would want to stress is that's not the whole picture. There is a wider picture of performance measurement going on in our industry. I don't know if that answered.

41.1.86 DONALD HOLMSTROM

I'm just trying to get a sense, even if you don't have an exact number. We're not talking about hydrocarbon releases in the North Sea amounting to a dozen or 17 or 8 events per year or anything like that.

41.1.87 BOB LAUDER

Well, the numbers were actually on the board there. Yeah and for major and significant, I think the number was 51 in the year just finished. So, there's essentially one a week somewhere in that category. But if I – and I maybe will sound defensive as I offer you this – but of that 51, they're all in a big bucket called "major and significant." I'll remind you of the criteria that I related to you earlier is that that would be anything between 1 kilogram of gas and 300 kilograms of gas in the significant category, and then you've got to go above that 300 to become major. In any typical year and if there is such a thing, we would

normally have around about 5 major hydrocarbon releases. So, they're the ones worth the real potential to cause devastation that we would be concerned about. Yeah. We're concerned about all releases, but they're at the high-end of criticality.

41.1.88 DONALD HOLMSTROM

Thank you.

41.1.89 RAFAEL MOURE-ERASO

I guess at this time, I'm going to ask Dr. Horowitz to bring some questions from the public, please.

41.1.90 DANIEL HOROWITZ

Okay, thank you, Dr. Moure. We'd like to, of course, adjourn as close to schedule as possible. So, actually, could I get a quick show of hands. How many of you think you will have questions from the audience? Okay, why don't you begin.

41.1.91 JAKE MOLLOY

(INAUDIBLE) Scotland, which is a long way away and it's a long way to go back tomorrow. So I don't want to go back without asking this question. It's for Mr. Williams. A Shell employee of some 40 years, I'm having some difficulty understanding. As I said yesterday, I'm not an academic, I'm not an engineer. I'm just an offshore worker. Shell is on OLF and participate in openness and transparency and support the principle of independent verification and independent regulators. Shell is on Oil and Gas UK in the UK and support all of those principles. Yet, I get the perception – and it's just a perception, I'm sure you'll put me right – that there's a resistance to all of that here and it's the same company. I can't get my head around that. I wonder if you can maybe enlighten me as to why that is.

41.1.92 CHARLIE WILLIAMS

So, I mean the question was that Shell doesn't support openness in the US?

41.1.93 JAKE MOLLOY

No, no. I said I get the perception that there's resistance to it by Shell here in the US and I don't understand why.

41.1.94 CHARLIE WILLIAMS

Well, of course, I'm a Shell retiree myself now, so I guess – I don't know. I guess I defer commenting on behalf of Shell, you know as being a retiree. But I'd say – and I guess my general remark is that I really don't think there is resistance to that.

41.1.95 DANIEL HOROWITZ

So we had several questions that were sent by email over the course of the afternoon and the first is from Graham Dalziel who identifies himself as a participant in the Cullen Inquiry. And he writes: *The inquiry into every major accident always the elicits the reply, "I don't think that could happen. I don't think it would be like that and I don't know why that wasn't – or I didn't know, rather, why that was important." In my experience a*

primary indicator is the knowledge of hazard, cause, effects, escalation and consequences. Does the panel have any suggestions how this can be assessed and developed into an indicator? Both the quality of the information provided to the facility and the resultant knowledge of the offshore personnel, together with their use of it to manage hazards. I don't know who would like to respond to that.

41.1.96 PETER WILKINSON

Could I speak – could I offer an answer to a question that Graham Dalziel didn't ask which is directly related to the point. And that is, one of the indicators for me of a company that really understands low probability/high consequence events is that they can articulate within the company the syndrome that it can't happen here. And some companies do that because this is a classic characteristic of a high reliability organization, or to use another term, a mindful organization. So, I'm sorry, I'm not answering the question directly. But some companies, and I know of one PTTEP but there are other companies who are actively developing processes to train managers and others in recognizing the psychological biases we have to accepting that these things can happen here. And, of course, there are some other psychological biases in addition to that one. Another important one is the tendency to dismiss dissonant information, information that doesn't confirm one's particular views. So, I won't go through the other characteristics, other psychological characteristics but I would mention Group Think also which is particularly well known in the US of course being a concept that originated in the literature in the US. So, a different approach that's an indicator for me that companies, about companies that really get this stuff is that they actually train people in these concepts.

41.1.97 DANIEL HOROWITZ

I wonder if anyone else has a thought on how awareness of catastrophic hazards can be reduced to an indicator.

41.1.98 BOB LAUDER

I certainly have thoughts on hazard awareness at workforce level. I'm absolutely owning up to not being smart enough to give you an answer right now on how do you convert that to an indicator. But, you know for sure in the UK offshore sector, there's been a significant amount of effort applied to trying to educate and ensure that the guys at the workforce level really did get major hazard awareness, did understand what the major hazards were, what their contribution was to managing those major hazards and basically where they fit into the respective. So, there's been an awful lot of work done on that. And you know if I give you a very personal experience, one operator I worked for, I personally conducted a whole bunch of workshops for technicians who were involved in safety critical maintenance who we had determined actually didn't get it, actually did not realize that the piece of cake they were working on was a safety critical component and that just to check the box that it's okay when they've reset a calibration point or whatever was not good, was not good in terms of major hazard management because you've lost a piece of history there, some characteristic of that safety critical component that needed, may need attention.

So I think there's been a lot of effort applied. There still is effort being applied. The safety case regulations in the UK do call for workforce involvement in the safety case development in the major hazard identification activities, etc. So, I think it happens. The move towards making that an indicator, I don't know where that will come from. I might actually have to again own up that the workforce engagement tool that Jake (INAUDIBLE) on this morning which we think is a robust survey type tool. I

think that does have some major hazard awareness element to it. It does try to interrogate workforce understanding of major hazard but I'm not sure to what extent it does that, to be honest. But there might be an aspect of that that would kind of reveal shortcomings and awareness.

41.1.99 DANIEL HOROWITZ

Mr. Williams, did you have a thought?

41.1.100 CHARLIE WILLIAMS

Oh, I was just basically I was going to say the same thing. I'm not sure about an indicator but certainly like I mentioned earlier, the key is that the people that are doing the work actually recognize and agree the hazards and barriers. And, so, the power of the tool of talking about that and agreeing the barriers and agreeing their role in maintaining them, it is important and I'm not sure about a safety performance indicator but certainly it's this thing that's easily measurable if you just go ask the worker do you actually know what barriers you're involved with and what's your duty to maintain them and what are you doing to maintaining the. So, it's a measurable item.

41.1.101 DANIEL HOROWITZ

The next question to you, Mr. Williams-

41.1.102 AUD NISTOV

Excuse me, excuse me. Can I just add. I think that question is very important, how to raise the awareness of major accidents. And on the Norwegian Continental Shelf, I mentioned the last major accident we had was in 1985, the last ignited hydrocarbon leak we had on the Norwegian Continental Shelf was in 1992. It's a long time ago and we experienced that a lot of the workforce working on the Norwegian Continental Shelf today, they weren't born when we had the Alexander Kielland accident when we lost 123 workers. So, we're trying, we try in every aspect to introduce awareness programs, whether it's introducing or making films showing simulations of what can happen if you have a normal hydrocarbon leak. And trying to get that into the head of my own understanding and everyone's understanding what's the potential of such a leak may be. So, I think this is one of the most crucial and important questions. Thank you.

41.1.103 DANIEL HOROWITZ

Go ahead.

41.1.104 GUNHILD EIE

I'd like to also add from my company's view that we also, it has been mentioned earlier on that it's very important that top management also has to understand, they know the major accident risks and also the mechanisms leading to major accidents. And we throughout last year, we developed a major accident course especially designed for top managers and had 12 training sessions mandatory for top management in Statoil, training 350 to 400 top management leaders in major accident mechanisms to raise their awareness and also increase their competence and understanding. But going from there to one indicator of major accident risk, as we also have heard these two days is that they are never the same, the mechanisms are complex and chains of events. And I believe that we are more, we are more on the right track if we

focus on risk management and the integrity of barriers to prevent major accidents, rather than looking for the one indicator. That's could sort of solve the question for us. Thank you.

41.1.105 DANIEL HOROWITZ

The next question to Mr. Williams is: *Was the committee formed in response to the Presidential Oil Spill Commission recommendation that the industry form, own, and fund safety institute?*

41.1.106 CHARLIE WILLIAMS

Yes, you know we actually started some work in advance of all the different commission reports but certainly the Center for Offshore Safety we feel like is alive with the recommendations from the Presidential Commission, and in fact, other commissions that reported out about SEMS in the industry and the importance of having an industry organization focused on that.

41.1.107 DANIEL HOROWITZ

The next question is for the panel. *How do you suggest to prioritize the near misses for analyses and follow-up since in an organization with well-designed near-miss systems, there will be a number of near misses reported to analyze.* And that comes from Dr. Oku Akhtar.

41.1.108 BOB LAUDER

My suggestion there would be – and it's a practice I've seen used quite successfully – is that in any of those events, you can apply a criticality ranking, if you like, some kind of potential matrix; and that would put it in the kind of top right-hand corner as a high potential near-miss, or the bottom left as a low potential. And then that drives your investigation and remedial activity.

41.1.109 JOE STOUGH

I'll add. We've seen where some companies put a criticality score, either a risk score that includes the severity and the likelihood potential together or just focusing on major hazard potential, just a severity score on each of the near-miss reports. So if you have a lot of near miss reports and we've observed this in cases where there is really mature reporting cultures in organizations that have a lot of near miss reporting, where they will use the score from either the risk or the severity potential to determine the treatment of the near-miss event. And, so, those that reach a certain threshold actually may even go through a formal investigation process just as though, as you would treat an incident at that same level.

41.1.110 DANIEL HOROWITZ

And the next question I think we'll take is a comment. *Considering the heavy presence of the UK tripartite in the panel, has there been any consideration given to just adopting the UK regulatory scheme here in the US, especially since the major players in the US already have to comply with the UK standards when operating in the UK theatre. It also seems like a lot of heavy lifting has already been done in the UK.* Well, that issue was settled in 1776 but in all seriousness, I think that part of the major purpose of both this hearing and the one we held in 2010 is to try to understand best practices from the UK and Norway and Australia and throughout the world. And, certainly, as we move through the remainder of the investigation to draw those into our final report to the degree we can apply those here. I think we will – if there are no other questions from the floor.

41.1.111 RAFAEL MOURE-ERASO

I would like to say, to again to thank the panel. I think we are very, very appreciative of you joining us here and having this presentation is quite useful for us. I have some closing statements. But before the closing statements, I would like to ask Dr. Horowitz perhaps to explain what is happening after this and our efforts in the Macondo Deepwater investigation.

41.1.112 DANIEL HOROWITZ

Well, over lunch, Mr. Bresland informed me of a slight misconception that the Board was done with this report today and it was the end of the process. Actually, this remains still our largest and most active investigation with most of our personnel involved one way or another. And we're right in the middle of it. So, where do we go from here? Over the next one to two months, we'll be developing our report specifically on the issue of safety indicators. That will be presented to the Board for a vote with proposed safety recommendations and the input that we got over these two days has been absolutely invaluable in that process. So, that will be the next -

41.1.113 JOHN BRESLAND

Daniel, that was not my misconception. That was somebody out here.

41.1.114 DANIEL HOROWITZ

Quite so. And in parallel with that activity, we continue to have a very active program looking at the failure of the blowout preventer. And those of you who followed this topic closely will know that there continue to be significant uncertainties about why that critical piece of equipment failed during the day of the accident and the days following. That is a very active area of research for us and we have one or more products under development over the next several months that we hope to present to the Board for consideration. And, once those are approved, we hope we will release those. And, then finally, we will draw all these threads together in our final report, which we plan for release in the first quarter of 2013. And that will cover human and organizational factors, risk management, corporate governance, and improvements that the Board may wish to see in how offshore safety is regulated. So, that's where we go from here. And, if the turnout and the level of energy here is any indication, I suppose we may well be back in Houston for our final meeting on the report when that's ready for consideration.

42 Closing Remarks

42.1 RAFAEL MOURE-ERASO

I would like to offer some closing remarks. I think that what we have heard during these two days it is unquestionable that the use of indicators to measure and manage safety performance with very complex high hazards, work environments is crucial for major accident prevention. I believe that seminal work has been done both in the United Kingdom, in Norway, and in Australia that has advanced the concept of indicator use.

The CSB's Texas City investigation, our report and the Baker Panel Report stimulated for the United States the discussion of the need for improved leading process safety indicators. And, much effort and emphasis has been placed in developing guidance for effective indicators programs in the United States. I can think of API 741 and OJP 456. I believe the statement made by the panelists and the speakers today demonstrate a strong and determined commitment by industry, by regulators, and by the workforce for the development and the implementation and use of safety performance indicators in the United States.

This brings the CSB two-day proceedings to a close. From a personal perspective, I would like to thank everybody for attending. Starting with our guests who joined us as presenters or as panelists as well as members of the media that have been here for the two days, members of the public who joined us for any and all of these events, whether live here or through the Internet or Web transmission of these proceedings. And I would also like to thank the CSB staff starting with the investigator team and also all the other people that contributed to set-up or communications department to set-up this hearing. Your involvement here has been instrumental in furthering our investigation and help to bring together some of the best practices and best ideas in the industry as our analysis turns towards fashioning recommendations aimed at us to prevent another incident like the one we suffered at the Macondo well.

And I also want to add my thanks again to the staff for their hard work and all of the board members of the CSB are going to bring this investigation to a close with, I am sure, will be an outstanding investigative report. So, thanks to everybody. I think I declare these proceedings closed.