BSEE BOLT FAILURE FORUM (AUGUST 29, 2016)

[00:00:01]

Hey well, Good Morning everybody

[Brian]: My name is Brian Salerno. I am the Director of the Bureau of Safety and Environmental Enforcement. BSEE for short.

Thank you for coming today. We are delighted that you were able to join us. Before we get started I just want to make a quick safety announcement, which is fairly obvious, you know, if there is an emergency, there are two marked exits, right here, its pretty easy to find. We are not anticipating any alarms or tests so if we do hear a bell go off, we will assume its real and evacuate.

For those who have not yet searched out the facilities, they are through the back door and to the left and right. So I've got all the essentials covered with that.

I want to welcome you all and thank you for coming today. I especially thank our two distinguished guests for being here, the Department of Interior Assistant Secretary for Land and Minerals Management – Janice Schneider, and the President of the National Academy of Sciences – Marcia McNutt and we'll be hearing from each of these speakers in just a few moments.

I also want to thank the members of our newly formed BOLT Action Team, the Interagency BOLT ACTION TEAM or IBAT for short. It's a group of federal partners from a dozen different federal agencies who are subject matter experts in the areas that are relevant to the problem at hand. We created the IBAT earlier this month so that we can bring together a group of federal experts who can focus like a laser on the problem of connector bolt failures. So I thank them for stepping forward and helping on this issue.

Now although BSEE is spearheading this effort, we really want to emphasize, this is a joint project. We are all receiving information, advice and counsel from a number of quarters including very helpful experts from within the industry. As many of you know, BSEE has been looking into the issues related to bolt connector failures for a couple of years now. There have been a number of incidents and what we might term 'near misses' that raise a concern about connector bolt problems and we have come to understand this is very possibly a global problem as well. We are aware of failures -- now that we are aware of them -- dating back as far as 2003. And just for the purposes of illustration, I'll just mention two of those instances because it serves to underscore the kinds of risks we are concerned about.

In 2010, a Blowout Preventer was being tested aboard a semi-submersible drilling rig – *Ocean Confidence*. She was operating in the Gulf of Mexico. As the test approached 14,000 PSI all 20 of the connector bolts failed. These are 16 inch bolts, 3-inch diameter, and of those 20 about… excuse me, 9 of them had the studs stripped and 11 were fractured. So they were all affected in one way or another. Now this was a shipboard test so there were no consequences to people and the environment, the consequences were really limited to the lost time and materials suffered by the company, but it's still a pretty serious failure of a critical piece of safety equipment.

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A second incident in 2012 took place during an actual drilling operation from the drill ship *Discover India*. In this case the lower marine riser package became separated from the blowout preventer stack. This resulted in a spill of 400 barrels of synthetic based drilling fluids. Again, this was traced back to a connector bolt failure.

Now these are just two examples but they highlight the broader concern. Now to its credit, the manufacturer of the equipment involved in the *Discover India* event proactively issued a recall of the suspect bolts and ultimately over 10,000 bolts worldwide were replaced.

The problem however is not limited to that one manufacturer, we're aware of other bolt failures involving other manufacturers. Overall, we are aware of, roughly, close to a dozen cases where bolts have failed. But no one really knows the full extent of the problem because until recently there was no required reporting unless an incident resulted in pollution or harm to an individual.

Now fortunately today, we've had no - as of today - we've had no major catastrophes resulting from bolt failures. However, given the nature of the failures that we have learned about, we believe it may only be a matter of time before our luck runs out and therefore we feel a great sense of urgency to get ahead of the problem and figure out what's going on before something does happen.

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Now Doug Morris, in his session, will really delve into some of the findings we've had on the cases where we've investigated. But it's clear to all of us that we need a much deeper dive to understand what the root causes are for this problem. We really need to leave no stone unturned and we believe that the bolt problem needs to be solved sooner rather than later.

Now we in the Bureau of Safety and Environmental Enforcement are responsible for offshore safety and that includes protection of the environment on the outer continental shelf. That's part of our charge, that's why we exist, and the public expects a pretty very high degree of vigilance on the part of its regulator. That's very clear in the interactions we have with the public and their elected representatives. They also, the public, expects a pretty high degree of care on the part of the industry who operates on publically owned lands including the outer continental shelf.

The bottom line is we all lose if there is a catastrophic incident and bolt failures could become the initiating cause of such an incident if we don't tackle it now.

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Now, I think it's important to take account of the fact that this problem may even be broader than just the Subsea environment. It's entirely possible that the kinds of issues that we've been seeing may also be present in other industries and in other locations. The kinds of issues we are seeing, you know, inadequate oversight of subcontractors, inadequate sharing of safety data, are not by their nature limited to a Subsea environment. And that's one of the reasons we established the IBAT, the Interagency Bolt Action Team - because our federal partners will be able to bring forth additional perspectives that are likely to help us collectively understand the full extent of the issue.

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Now I can't overstate our appreciation for the help we receive from our federal partners but I am also very appreciative of the assistance we hope to receive from the National Academy of Sciences. Now this is still a subject that is in the hands of Contracting Officers and they tell me I can't say anything about it yet, but we're hopeful that they'll resolve that and that we'll actually have National Academy's engaged as well.

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These will be two separate but parallel tracks that should lead us to the solutions that we very much need. So today's forum is an important step forward in our effort to find a definitive solution to the problem. So again, I want to thank you in advance for your interest in the issue.

We'll be covering a lot of territory today but before we get more deeply into the technical issues, I want to turn the podium over to the Department of Interior's Assistant Secretary for Land and Minerals Management – Janice Schneider.

[00:09:11]

And just by way of introduction, Assistant Secretary Schneider oversees a number of Bureaus within the Interior Department, including mine – BSEE. She began her career as a Fisheries Biologist and an Environmental Consultant and then went on to obtain a Law degree from Lewis and Clark Northwestern School of Law where she specialized in environmental and natural resources law. Prior to her present appointment, she held positions with the Solicitors Office at the Department of the Interior, she served at the Department of Justice within the Environment and Natural Resources Division, and she's also worked in private practice as a partner in the Law Firm of Latham & Watkins where she was the Global Co-Chair of the firm's Energy and Infrastructure Projects Citing and Defense practice. So, in short, Janice has been around energy and natural resource issues for a number of years and I know from my interaction with her that she's intensely interested in helping us meet the challenge of failing connector bolts.

So, please help, join me in welcoming Assistant Secretary – Janice Schneider.

[00:10:21]

{Claps}

[00:10:24]

SPEAKER: Janice Schneider

[00:10:27]

Thank you Brian.

Okay.

I wear glasses but I know they're not going help.

{Laughs}

So I am going to hold this up here if that's okay.

Thanks everyone for being here this morning and Good Morning to all of you and for folks who are watching at home.

I wanted to join today because I think we all realize what a very serious problem we have on our hands. As Brian mentioned, I have worked with the energy industry for, I'll say, many many years or even many decades as the case maybe.

And really, as we all know, the importance of functioning reliable equipment, components and parts, cannot be understated. I know it can be challenging to convince others of this fact and their significance. For most people, bolts are really as generic as it gets and a lot of people just assume, you know, of course they're going to work. However, the two examples that Director Salerno just cited demonstrate not only how critical bolts are, but also that the failure of such a simple component has the potential to lead to a major problem, and as the offshore oil and gas industry continues to move into deeper waters and more challenging under sea conditions, it seems to be that our challenge becomes even greater.

You know, I read an article recently in the Wall Street Journal, quoting a CEO of a major offshore drilling company who told investors in June that the company had four, count them – FOUR, unplanned stack pulls in the second quarter, three of which involved failed bolts. That's just one company and that's in just three months. So this is very serious business. So I am here today to communicate a very simple message to everyone in this room. We need you, we need your help, and we need your support.

As Director Salerno said, together we will figure this out. It will take determination to solve the problem and the resources to make it happen. BOTH will be brought to bear in this effort.

The Department of the Interior is putting extensive resources into this effort, but due to the seriousness of this issue, we want to make sure that all top thinkers in this area are engaged in helping us solve this problem.

As Director Salerno just mentioned, we suspect that the issues that BSEE is seeing goes well beyond the industries that BSEE regulates and this may potentially impact other safety related equipment. So this work that we are asking you all to participate in has broad ranging applicability.

For these reasons I share Director Salerno's appreciation for those federal experts, both within the Interior Department and outside the Interior Department, who have stepped up as part of the Bolt Action Team and I also look forward to working with the National Academy of Sciences to conduct, hopefully, once we get this contracting stuff worked out, a thorough study of the problem.

Many of today's participants are experts on this topic. Some of you are here because you are trying to understand the problem. And, some, like me, are here to offer support for BSEE and the other entities that are involved. Some of you are probably part of a work group setup by the American Petroleum Institute, a parallel effort that is addressing the issue of bolt failures. And some of you represent affected industries.

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Be assured that the Department of the Interior is 100% behind everyone's efforts to solve this problem and to solve it soon. Between our collective actions, whether it's prior internal BSEE investigations, the BOLT Action Team, the National Academy study, forums like these, and industry leadership, we will have the ability to better understand the breadth and the depth of the bolt problem.

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So, I commend your Bureau, Director Salerno, and our many partners for having the foresight to act proactively. This is exactly how an organization operates when it lives its mission. The American people expect us to operate with safety as our first priority, and your efforts to solve the bolt problem before it makes the headlines demonstrates that BSEE is really living up to that expectation.

I know that across the vast expanses of the outer continental shelf, with all of the various facilities, a lot goes right on every given day. In the five years since BSEE was created, we have seen that there are bends in that arc towards a safer OCS. There are lot of hard workers out there doing their jobs well and a lot of companies that are committed to fostering a culture of safety.

But I think we all know that it only takes that one combination of circumstances to put all of our safety systems to the critical test. With so much riding on our critical safety equipment, we have to make sure that all components, including bolts, work as designed.

Everyone is counting on you and us to make sure that that's the case. This is a problem that is going to be solved because we have the best minds working on it, including all of those of you sitting here today.

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All of us know from experience that prevention is vastly better than responding to incidents. So while some may worry that the cost of fixing the problem maybe too great, we really need to set that aside. We need to be driven, as the director said, by the public expectation, that we're assembled to prevent the possibility of a catastrophic failure. Anything less than our best efforts to solve this problem, are simply unacceptable.

In a few years from now, I am hoping we can all look back and feel good about the fact that we were part of a solution that prevented a problem from actually fully manifesting. You know prevention never makes headlines.

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But there is no nobler calling than the call to save lives and to protect the environment. And that is exactly what is happening here today and that's the journey upon which we have all embarked.

I want to close by thanking all of you for coming today, for your willingness to help, to listen, and to learn and to support this effort to find solutions to this very critical issue.

Thank You

[00:16:58]

{Claps}

[00:17:03]

[Speaker: Brian Salerno]: Well, thank you very much Janice. And let me just say, we truly appreciate your support and your encouragement as we collectively seek to tackle this issue and we will certainly seek your advice as we proceed in this process as well.

[00:17:20]

Our next speaker is Dr. Marcia McNutt who I am quite sure is well-known to many of you. She has a long and very impressive list of credentials. She earned her PhD from Scripps Institution of Oceanography. She was the winner of the 2007 Maurice Ewing Medal for her contributions to deep sea exploration and of course she was a professor at the

Massachusetts Institute of Technology. And that's just for openers.

Since 2009, when she came into the Department of the Interior, I think initially as an advisor, a Science advisor to the Secretary and then subsequently appointed as the 15th Director of the US Geological Survey. You know when she was appointed, that's a Senate confirmed position and she received unanimous support from the Senate which I think is quite impressive. That's, that's not an easy thing to do. When the deep water horizon tragedy happened in 2010, she was thrust into a leadership role in helping to solve those problems and in particular she led the Flow Rate Technical Group working directly under the National Incident Commander.

I am sure many of you can remember the daily media footage on CNN every night and many other news outlets, looking at the rate of discharge, remember that video of the flow, no one could figure out exactly how much was coming out, that was critically important from an operational response perspective but also from legal perspective. Well, Dr. McNutt figured that out with her team.

In 2013, she became the Editor in Chief of the prestigious Science Magazine where she's been credited by setting up that publication for success in the modern publishing environment.

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And then in 2015, she was named as the next President of the National Academy of Sciences, a position she assumed during the course of this summer. By the way, those last couple of items, she was the first woman; she was the first woman to lead the USGS, the first woman to become Editor in Chief of Science, the first woman to become President of the National Academy of Sciences. So I guess, you know the…I don't know where to stop with your list of credentials but I'll stop there. It's a very long and very inspiring list. So please join me in welcoming Dr. McNutt.

[00:20:02]

{Claps}

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[Speaker: Marcia McNutt]: Okay, it's just embedded so it should play.

[00:20:15]

Well, good morning everyone and thank you very much for inviting me to speak at this very important forum.

So, I decided to take a sort of larger view, rather than talk about the bolt problem in general, talk about this general issue of problems when there's not an option. And, I am thinking about this, I remember distinctly a presentation I heard from a former colleague of mine, Nancy Leveson from MIT, who is an expert in Industrial Safety and she and I were on a panel after Deep Water Horizon and she reported on a conversation she had heard from some people who thought that in the wake of Deep Water Horizon that while as tragic as that oil spill was, they felt that oil spills were going to be very difficult to stop simply cause drilling in deep water with these complex well heads had simply become so complicated that it would be very difficult to make them absolutely fool proof. And Nancy's response to that was, there are many engineered structures that are very complicated and yet we have made them virtually fail safe. And one example she gave was the fact that nearly 2 million people in the US alone put themselves into aluminum cans that go up to about 40,000 feet every day in the air and come back to the ground safely after traveling perhaps thousands of miles and they do that largely without incident. And that is a very complicated process.

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And if they couldn't do that safely, the airline industry basically would not be a profitable enterprise. She used that as but one example of an industry that has had to look at all modes of failure and track them to the ground in order to be profitable.

Now it's not as though accidents don't happen but they are rare (point to screen) this is one of the few that, certainly, I mean we do have terrorism but there aren't that many that cause major loses of life due to actual failure of the aircraft itself. This was one of a Concord that happened in July 2000 that was taking off at a runway at Charles de Gaulle [International Airport, Paris] and this was an interesting one because it brings up a point that Assistant Secretary Schneider said from the stand point that…I believe everyone on this plane died in this one. It was this small (pointing to screen) piece of debris on the runaway that caused a tire to blow on the Concord and the debris from the blown tire came back and hit the wing and hit the engine and the Concord crashed. And as you all know the Concord is no longer flying, of course there were reasons other than just this crash, but it was the beginning of the end for the Concord.

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So, sometimes it's the little things that cause problems. Another example of the simple things that can cause disasters, Assistant Secretary Schneider said that a bolt is a simple thing. Another example of a very simple thing is an "O" ring and everyone recalls the Challenger disaster that began with a very simple thing that was an "O" ring and these "O" rings on the Morton Thiokol solid rocket boosters were tested on certain conditions but here was a very unusual condition where they had freezing temperatures in Cape Canaveral, Florida. So here was as a situation where these were operating out of their normal operating conditions and they had not been thoroughly tested outside of these normal operating conditions. So again, it was a failure in testing.

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Another example was the Columbia Disaster where the space shuttle disintegrated over Texas and Louisiana and the problem was tracked back to the launch where a piece of foam insulation broke off the external tank, struck the left wing of the orbiter and at that point it caused damage to its thermal shielding which could not have been repaired in flight and caused problems on reentry.

Now, let's turn to the ocean and compare what some of these problems are to the ocean because I want make the point that I think some of the problems we have to face in actually tracking down failure modes in the ocean can actually be more difficult than just making the Challenge or the space shuttle flight safe. So let's look at ocean versus space in terms of power and the problems we have to face.

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If you want to power a space craft, all you have to do is put solar panels on them, unfurl them, and you've got power in space. If you are working under the sea and you want to power something, you've got a very very difficult problem because you cannot just use solar panels because solar energy does not propagate under water. So instead you either have to use batteries, you have to use cables or some other way, you know, submarines use nuclear reactors, getting power into the deep sea is a much more difficult undertaking and many of the failures we have in the deep sea have to do with power failures – either lithium battery failures or failures of power systems or batteries running out. This is something we don't have in space to the same degree that we have under the ocean.

So the advantage is definitely in space in terms of trying to deal with power systems.

If we look at communications, again, the advantage is in space. Electromagnetic signals travel easily to space. We could talk to the Pluto Mission easily all the way out at the furthest edge of our solar system whereas it is very difficult to communicate under water, we have to use cables, we have to use sonar which has much lower bandwidth, so the advantage to space in trying to communicate, again we can have communication failures when cables break, we have multi pathing affects, we have all sorts of difficulties communicating under water and again a lot of failures happen. Or sometimes we have problems determining what actually the failure mode because of problems in communication was. So that's why there are difficulties under water compared to space.

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Fouling. You can put something out in space and it can be out there for decades surveying Jupiter, going out to Neptune and if you look at it decades later, it will look no different than the day it was launched. You put something down in the ocean and pull it back, the one in the lower left hand corner, (pointing to screen) was out in Monterrey Bay for a matter of a month and it comes back looking like that (on screen).

The one on the right (on screen) it went down as the seismometer in the upper right hand corner (on screen) and came back as a massive sulfide deposit a couple weeks later. So there's bio fouling and there's geo fouling that happens in the ocean which makes it very very difficult. There's corrosion that happens in the ocean, there's deposition, and there's bio fouling. So all of those make it much easier to put something in space and expect to get it back like it did – that never happens in the ocean. There's corrosion that happens in the ocean, there's deposition, and there's bio fouling.

So again the advantage is space in terms of anything that happens chemically, biologically and physically. Now the one place where oceans have the advantage is in the launch. Every time I have gone out to sea and thrown something over the side of the ship, we've had a successful launch. It is indeed gone to the bottom of the ocean successfully and in fact if you go back to the problem with Challenger and Columbia, both of those problems can be traced to problems at launch. The "O" ring failure and foam insulation failure, both of those were actually problems at launch. And so the ease of launch translates into practically no penalty for weight in the oceans as compared to space and so the one thing we can say is that oceans do have an advantage on the launch and that's about the only advantage that they do have.

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Okay so does that mean therefore that all of these translate into much more difficult…should we throw our hands up in the air and say that we can't solve these problems in the ocean, or was Nancy Leveson right, that there is a systematic way we can go in and solve these problems in the ocean.

Well, one point that Nancy made when she brought up this man (point to screen) Admiral Rickover. Admiral Rickover was basically the father of the Navy's nuclear fleet and for 30 years he oversaw the development and the advancement of the US Navy's Nuclear Submarine fleet - and in particular, I even recall, in 1963 when the Navy's quietist and fastest submarine - the *Thresher* - was lost with 129 hands aboard in 1963 during actually one of its testing cruises. And there are still theories as to why it was lost again because of problems with communication but Rickover was extremely upset over the loss of the Thresher and he implemented a rigorous submarine safety program which he called SUBSAFE. And what's interesting about that is before SUBSAFE, the Navy lost 15 submarines in non-combat incidents. Since SUBSAFE, only one submarine has been lost and that one submarine was not SUBSAFE certified.

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So that is a pretty incredible record. 15 prior to that, zero SUBSAFE-certified subs and only one that was non-SUBSAFE certified. So I think my question to all of you, therefore, going forward is, who's going to be the Admiral Rickover for your bolt problem? Who is going to step forward and say, "I am going to come up with a program that is going to make deep sea installations safe and come up with a testing and certification program that is going to solve this problem." Such that prior to this we've got this record of failures and afterwards, any installation that goes through this certification program, zero failures. And I think that's a worthy goal.

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Now I should say that after (…is there another slide? I guess its missing)…well, the National Academy did do a post-Challenger evaluation that was asked for by President Regan and the National Academy recommended that there would be a full systems approach to the continuous identification of safety risks, not just failure modes and hazards and quantitative objective evaluation of safety risk, and all of this was very much in keeping with Admiral Rickover's approach to addressing the safety problems in the Nuclear fleet.

So I'll end there and wish you all much success in your task ahead.

Thanks very much.

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{Claps}

[00:38:03]

SPEAKER: Brian Salerno: thank you Dr. McNutt. We really appreciate how you taking the time to share your thoughts and really an inspirational message. I've always been intrigued by the SUBSAFE program myself and I think that's a very useful challenge to us today.

At this point, I believe Doug Morris is going to introduce the first panel or at least where we are going with the first panel. So Doug, would you like to provide that?

[00:38:38]

SPEAKER: Doug Morris

[00:38:40]

Would you guys come on up.

[00:38:55]

Thanks Brian. I have with me today Joe Levine who is the Head of our Emerging Technologies Branch, Troy Trosclair who is a Deputy Regional Supervisor Gulf of Mexico Field Operations, and Dr. Candy Hudson who is the Chief of the Systems Reliability Section.

Our goal is in this first session is to describe what we know and what we don't know concerning this issue. During the second session we will discuss the path going forward. However, I would first like to (slide coordination off mike) …

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… I would first like to tee up the issue by giving a description of our Bureau and our off shore operations. Here's our Mission Statement which is to promote safety, protect the environment, while ensuring the diligent development of offshore resources.

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We have broad jurisdiction over federal offshore lands; we have more than 800 people located in Washington DC, Louisiana, Texas, California and Alaska.

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There are currently more than 2,300 facilities that bring oil and gas to the surface and transmit it to the shore. These facilities produce almost 20% of our domestic crude oil production. They range from relatively simply structures located in shallow water to billion-dollar deep-water projects, and we are required by statue to inspect each of these facilities at least once a year.

We are also responsible for providing oversight of drilling rigs that move on to a lease and to the wells that produce the hydrocarbons. At the end of July, despite low oil and gas prices, we had 55 rigs operating in the Gulf of Mexico.

There are four general types of drilling rigs that operate on the OCS that are demonstrated here (on screen). For the purpose of today's discussion, we are focused on deep water drilling rigs that use Subsea blowout prevention equipment. So that's the semi-submersibles and the drill ships.

Here's a picture of a floating drilling rig (on screen). The blowout preventer is located on the sea floor. This equipment is used to confine well fluids to the well bore. That's a definition out of API Standard 53 and in an emergency to shut in a well and prevent a blowout. So when it's needed, this equipment simply has to work.

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And here's a picture of a BOP stack (on screen). I am not going to describe how it works except to state that this is a huge piece of complex equipment containing multiple components that must work in very challenging environments.

Various types of bolts, studs and fasteners are used to assemble and connect all these components. As we will be discussing in a moment, there appears to be issues with the various fasteners used in this equipment. As noted before, the fact that we are experiencing problems with what was assumed to be the simplest component in a complex system is troubling to BSEE and the reason for this forum.

[00:43:08]

Two other items for consideration before we get started. First, this equipment and these drilling rigs, are moved from lease to lease and often moved to other areas of the world. As a result, this issue has potential international impacts.

Second, when addressing issues related to this equipment, we have three parties involved.

We have the original manufacturer, the drilling contractor who owns the BOPs and performs maintenance and repair, and third, the operator who hires the drilling contractor to drill a specific well. Each of these parties has legal and commercial considerations that complicate the resolution of this issue.

Okay, let's get started. I am going to turn this over to Joe Levine.

Joe

[00:44:08]

[Speaker: Joe Levine]: Thank you Doug. Good Morning everybody. We have a pretty intimate crowd which is good, that means we have managed to get just the specialists and people that have a vested interest in connector reliability, so I think that's a real positive step.

I'd like to echo everything that Janet and Brian, Marcia, and Doug already mentioned in regards to connectors and their use on the Outer Continental Shelf.

[00:44:53]

Ok. Basically, this session will look at two things - actually three. First, I'll give you a brief overview of the technical evaluation process - the one that we have put into place, which led to the published evaluations on connectors.

Then, Troy Trosclair from our New Orleans office will get up here and discuss four or five of the connector failures that we've experienced, both the ones that we have our reports out on and several others that we're currently investigating.

Then Dr. Hudson will follow up and provide us more of the details in regards to the various areas of concern the agency has become aware of in regards to connector manufacturing, materials and operational procedures. So, that's how this session will go. I think it's probably best if we just kind of keep any Q&As to the end of the session. At that time, we'd be more than happy to address anything that we can with you.

[00:46:27]

Ok, as Doug mentioned, his office, the Office of Offshore Regulatory Programs, this is the office where we conduct our technical evaluations out of. Basically, this first bullet is my vision/view on what we're trying to do with these evaluations. We're evaluating a piece of manufactured equipment, a failed piece of manufactured equipment, trying to determine whether it was fit for service or not. What I mean by that is that, as you all know, there is a series of manufacturing specifications and recommended practices that are put into place that an OEM abides by when manufacturing the widget. Here, we're talking about a fastener. Then there's also a series of operational or environmental parameters that the widget needs to function within during its life. This could be the external hydrostatic pressure -- 10,000 feet of water, 4,400 PSIG bottomhole pressure -- inside the equipment. 10,000 PSI bottom hole temperature, 300 Fahrenheit external temperature 31 degrees corrosive sour conditions inside of it, sediment, high flow rate. So, these are the operational conditions. So, we look at the piece of manufactured equipment during our evaluation and we make an assessment through our work - if this piece of equipment truly was designed, manufactured and used within its fitness for service envelope.

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As we go through the report, one of the two goals that we are trying to accomplish is to identify any gaps in BSEE regulations perhaps that are governing this piece of manufactured equipment or any gaps in the industry standards that are either incorporated by reference in the regulations or not incorporated by reference. As an example, we have subsurface safety valves 14A that's in the regs and 20E has come up in fastener discussions - it's not in the regulations now. So, we look to see if there are gaps in the regs, standards, or any other kinds of processes that we've identified as possible contributing cause to the failure and the goal will be, as we move forward, to try and address and close these gaps.

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I think it’s really important to look at the differences here between these technical evaluations and the more traditional MMFs, BOEMRE, BSEE Regional Panel investigations and District 2010 investigations. They are two different animals. Those of you that have been in this business a long time know the 2010s and the panels - we conduct these investigations when there's been an accident or an incident, in accordance with our 30CFR Subpart A requirements, we state out when an operator needs to tell us about an accident, an injury, a fire, a loss of well control, etc... We conduct these investigations - they're fact finding, yes, but there's also an enforcement component to these 2010 and panel investigations. We're looking to see compliance with 30CFR regulations, incorporated standards, and, perhaps, what I call conditions of approval that have been attached to an application for a permit to drill or an approved plan. We're looking for violations there. If we find a violation, we conduct an enforcement activity, such as issuing an INC - Incident of Non-Compliance, or a civil penalty which is currently $40,000 a day per incident so there's an enforcement component to these traditional 2010 and panel investigations.

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The technical evaluations that we do - the two on the failed connectors - we have no enforcement associated with it. They are 100% evaluate, find out facts, share the information with the goal being to raise the bar of safety, raise the bar of environmental protection on the OCS and perhaps globally. So, there is a big difference in these two kinds of investigations.

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Looking further at our technical evaluations, I look at it also as BSEE is independently validating how the OEM, the manufacturer has used the RPs and specs in regards to quality assurance, quality control, and designing and manufacturing the widget, such as a connector. We're also independently validating its ability to perform within the fitness for service requirements I've already mentioned and how reliable and dependable the device is. So, that's another one of our guiding principles as we conduct our technical evaluations.

[00:52:55]

The second bullet - industry collaboration - is critical. We made the initial assessment on this a few years ago when we first started on our technical evaluations. If the goal, like I said, is to improve safety, protect the environment, look at some causes, share the information with industry to prevent similar occurrences happening in the future, we felt the best way to do this was not to have the agency conduct these evaluations in a vacuum but to actively collaborate with our partners and any of the companies in this room that have been involved in any of the three technical evaluations we've conducted know that we mean what we say here. We conduct a draft report and we send that draft technical evaluation report to the OCS operator, drilling contractor, and OEM separately and ask for their input and their concerns and then we actually go down and meet with them face to face over a series of meetings and discuss the points. And, that way, we feel we end up with the best product because we have listened and we have tried to address everybody's concerns. I'm not saying we always take every comment, you know, like a rule making - we don't, but we definitely listen and, as some of you know, we discuss all your points so we decided collaboration was key to making this a successful program.

[00:54:48]

You'll also see in our reports a series of recommendations. These recommendations, after we've conducted an evaluation, go back to either the agency or the industry. We may say to ourselves this situation here reeks of policy and procedural deficiencies that we need to change or new regulations that we have to implement or NTL - Notice to Licensees -- that we should set out. We also have recommendations back to industry - modify existing standards or develop new standards. Here in connectors, I know API has an active work plan on this point here. We have some recommendations that Candi will go into in more detail, but we have some recommendations on inconsistencies amongst the various API, ASTM, ASME standards in regards to material properties which govern manufacturing of connectors; so API has formed a work group, set us a work plan, a pretty robust work plan. I think Trent over here is spearheading that project to try and look at this, try and harmonize some of the information and the standards better. We also have recommendations on safety alerts. After we released our first evaluation, we also followed up with a safety alert. I think it’s a real good way to share the information and our concerns with industry. And, finally, another recommendation could be a research project. We may believe we really don't know enough to manage the issue in the best way possible and perhaps research is a good solution. It could be a BSEE sole source kind of research project or my favorite - the JIP [Joint Industry Project]. You get a broad cross section of companies in a JIP so I think you get a better product out of the research. So, we have a whole host of opportunities here to address the concern via these recommendations.

[00:57:29]

Before I pass this off to my colleagues, I had a couple of observations I think others before me today kind of hinted at this but -- before two or three years ago when we started our technical evaluations -- if I ever thought about a connector at all, when I looked at a subsea BOP, a two hundred-ton BOP, $500 Million dollar BOP, if I ever thought about a connector at all, I thought it was an inconsequential, insignificant piece of hardware. But I'll be honest, I never thought about a connector at all. I looked at this subsea stack or an LMRP riser system as, you know, was it designed in accordance with appropriate documents - is a company following the 30 CFR regs, etc.. Now, today, I certainly don't see a connector as inconsequential or insignificant. I see it as critical piece of hardware which is really the Achilles heel of this critical piece of equipment. If it's not functioning right, if it’s not manufactured correctly, all it takes is a couple of those and we can have another Macondo or something similar from this piece of equipment. So, I look at it totally different today. And, also, now that we've had a couple of years to kind of look through some of the information on connectors, it kind of surprised me in the years 2001, 2002, 2003, etc. when you look the reports, we've seen these failures before. It's not a brand new occurrence. I think the difference is back in 2003 when we started getting this info trickling in willie-nillie, BSEE -- MMS at the time -- and industry really just looked at it as: "oh, a bolt failed, ok, let's correct it and continue operations. Let’s correct it continue permitting evaluation" So, that mind set has totally changed today. I don't think anybody in this room looks at it as a bolt failed, replace it, and move on. I mean now we're trying to really understand why it failed. So, those are some of the observations that I've picked up over the last year or so, that I've been conducting this work on connectors. So, I will end and I will pass this on to Troy Trosclair. I'm sure most of you know Troy. He's out of our New Orleans regional office - a deputy regional supervisor. Troy and I have actually worked together on and off for 25 years so I know him fairly well and I'm sure he's got some good input to provide the group. There you go Troy.

[01:00:54]

[New Speaker – Troy]: I first apologize, I'm from southern Louisiana, so my accent, some people say I have an accent - I don't think I do and this thing might not be tall enough. But, excuse me; I hope I don't need any kind of interpreter. But, thank you Joe. I tell you what; I do like the outcome here. It looks like a lot of people are interested in this issue, and it is definitely something that we need to get a grasp on. (Make sure I can follow these.) OK, as you can see, this is a summary, and BSEE has been looking at these incidents that have occurred for the past several years, and there have been several fastener failures on these critical pieces of equipment for well control, specifically the BOP stack. And, it did not affect just one BOP manufacturer; in fact, it affected all three of the major manufacturers for BOPs. I'm going try to go through these things fairly briefly -- these incidents -- but this is kind of a summary of these.

[01:02:04]

The first one the director did mention this one a little bit, and I'm going to go into a little more detail of this event. This was an LMRP failure (and real quick I'm going to see where the pointer is on this thing - That was not it - Is there a pointer on here?). Alright, so right here is an LMRP connector here, and as you can see on the bottom of this, this is actually what they call a well head connector. So this event, this event with this LMRP connector that separated, which had all 36 bolts fail, and of course there was a release of 432 barrels of synthetic based fluids, this event was not only affected LMRP connectors but it also affected several rigs that actually had that same connector as the well head connector, and as you can see the BOP stack itself was right here, so if that would have failed, it would really had a serious problem here. You would not have had the BOP stack in place. So the OEM at the time actually recalled approximately 11,000 of these fasteners. One other thing that I want to make a point of, here is the actual connector itself with all the failed bolts, but this actually had a pollution event associated with it, so BSEE was contacted because 30 CFR 250.188 requires you to report incidents of pollution. So this was reported to us, we immediately initiated an investigation, part of that investigation was to ask the company to come in with a preliminary root cause analysis of these bolt failures, and about a month after the incident had occurred, they did come in and brief BSEE on the incident and what was the outcome. From there, BSEE actually contacted OEM and their equipment manufacturer, and tried to get what scope are we talking about as far as Gulf of Mexico rigs and how involved it is, and what kind of impact it is going to have on the Gulf of Mexico operations. They listed 25 rigs was associated with this. So one of the things that BSEE started doing was calling the operators of those contracted rigs and trying to find out, hey were you aware of this bolt incident and the manufacture did go out with a bulletin, and what is your plan forward as far as your well operations? And what wind up happening was that BSEE did order these companies to go ahead and TA [Temporarily Abandon] the wells that are at a safe stopping point, pull the stacks, and replace them with other bolts, other bolts that actually had, I think Dr. Candi Hudson is going to get more into the metallurgy and some of the findings of the bolt issue, but what this one was, I think, was a post-heat treatment of some of the coatings. So all of these rigs had to replace those bolts with the newer bolts and one of the other things that BSEE also required was we wanted our certificate of compliance that the coatings had been post-baked accordingly, we wanted a third party certification of that. We also wanted a third party certification that the BOP was now fit for service.

[01:05:27]

But, one of the main things to look at, like I said before, this part right here, if there was failure, and it was a well head connector, it could have been a bigger difference, in fact this well here, it actually was 1,500 feet below the 18 inch shoe, so it was a benign hole section that they were in, but it could have easily been a well operation where they could have had exposed hydro carbons and if you had exposed hydro carbons and you had a failure on this, you actually would not have had any protection what so ever, so...

[01:06:05]

Next event, June 2014, we had a failure. Now this one was the actual BOP stack was actually on the deck, on the stump and they were doing some maintenance, in between well maintenance. And what they found on that connector was there was 9 out of the 20 fasteners had failed. This also was an LMRP connector. This was considered a near miss event.

[01:06:38]

This one here on October 2015, the blind sheer ram actuator fasteners had failed. A lot of folks call this the booster cylinder, but this is what takes the hydraulic energy to actually ensure that the blind sheer ram will cut pipe that is inside of the BOP stack. And this failure here, 6 of the 8 fasteners had failed on the upper ram. We currently, BSEE is currently still evaluating this failure, but some of the others - this is the photograph of the fasteners that had failed in this situation here. This is how they found it, and as you can see some of the bolts are on the outside. We had some other known failures; these happened to be the blade connectors, so here is your Ram Block, and here is your actual blade, your cutting blade, and here are the fasteners that actually attach the blade to the block. And, in these cases here, these bolts had failed. Now that is what holds the blade in place, to be able to cut the pipe - the drill pipe. So, we have had several of these incidents but, fortunately, these incidents occurred while they was on deck doing stump testing, and it didn't happen while anything was in service, but this could be the same kind of thing, if this would have happened while you ran an actual hole section that had an open reservoir to it, we could have a problem, and be unprotected, so....

[01:08:23]

From here, there was some subsequent failures, and the equipment manufacturer went out with a safety notice, and the fix was to go ahead and reissue new bolts that was a 3/16th inch thicker flange, and I know that I'm probably talking solids, but anyway that was the fix on that. One of the things as BSEE starts to look into these bolt issues, we found out that there were a lot of other bolt issues that we really didn't know about and it makes sense though because the only time we are going to find out something is if it is a reportable incident. If there is a pollution incident, or some other accident that is reportable based on that 188 regulation, so from that we found out that there was several of the fasteners that had failed, and I think that the director spoke about some of these. But, that's one of the things that I wanted to talk about, you know those blade incidents, the way we found out about it was that the equipment manufacturer actually sent out a bulletin to the rig contractors and the rig contractors of course got with the operators, and some of the operators actually said: "hey, I think BSEE might need to know about these issues", but there was a gap of time there, so some of these bolt failures we didn't find out about them until about a month and a half after some of the incidents had actually occurred. Hopefully, with the new requirement, the new well control rule, actually I think it's 257-30 Charlie, requires now that these failures to be reported to BSEE to OORP, to Doug's group, and hopefully we'll be able to get a little bit, reduce that gap of time, you know, so that we can be a little bit more proactive as an agency on this, and get involved.

[01:10:22]

One of the other things that I wanted to talk about is one of the impacts, this is just, so for the first one, the LMRP connector, we had 25 rigs that was affected, not only was it 25 rigs affected, but you know after the *Deepwater Horizon* incident, we are required to have a containment, every deep water operations had to have a containment demonstration, or a containment plan. One of those connectors was associated with the MWCC - one of the containment groups, stack also, so at that time we had to get that changed out, because that was one of the rationale why you were able to go ahead and drill, because you do have this containment equipment on the beach that is ready to be deployed. The average down time -- and this is was not a whole lot of science -- but I just took the days, because what we did was we just tracked the days from the time the stack had to be pulled to the time the stack was ready to be deployed back into the water, and just divided the number. It was an average of 17 days that the stack, just for this replacement of these bolts. LMRP connector failure on June 14th - only one stack, and that stack was actually on the rig, so there was zero days there. The BOP actuator failure - there were two rigs involved, pulled the stacks and replaced those fasteners - average of 18 days downtime on that. The upper blade fasteners - both the failures - this was in March 2013 - two rigs, one rig the stack was actually on deck conducting maintenance, and the other stack had to be pulled and replace those fasteners. That's why you see 7 days, there was actually 14 days for one rig, and this other incident that happened in December 2014, along with May 2016 - the one that happened in December 2015 was a blind sheer ram failure, but the most recent one was also associated with blind sheer rams, and it required 8 rigs to pull their stacks and replace those fasteners. An average down time of 12 days, but I believe...is that all that I got here?

[01:12:32]

Yeah, that's all I have here. But I just want to echo the sentiments of Assistant Secretary Schneider and Director Salerno exactly what he stated before, that these incidents, that we definitely need to get on top of this, get a hold to it, and this critical piece of equipment, the BOP stack, that's our safety equipment for drilling operation subsea, and so if we don't get a hold of this, quite possibly we could have another incident, and as Dr. McNutt stated: "Failure is not an option, not for industry, not for this agency, and definitely not for this country", so I'll turn it over to Dr. Candi Hudson, she'll probably get into a little more into the details of these failures. I appreciate your time.

[01:13:17]

[NEW SPEAKER: Joe Levine]: Thank you, Troy. Yes, Dr. Hudson now will give us an update on some of the areas of concern from our evaluations.

[01:13:32]

[NEW SPEAKER - Dr. Candi Hudson]: Thank you Mr. Levine. Thank you Troy, I'm going to speak in more detail and ways about the material based failures. I'd like to give a disclaimer also about my accent - I tend to pick up the accents of others - I spent time in the deep south as well, I spent time in the mid-west, the east coast, and have a lot of friends from the UK so I tend to pick up accents. (And I need actually a little help, I can solve a non-linear, homogeneous equation but I can't seem to operate the prompter. Middle button? Oh, thank you!) Ok, so going a little deeper about the first fastener failure, some of the key findings, what BSEE has identified in general, is that there is a significant material properties gap. There is a difference in requirements of the material hardness, the ultimate tensile strength, and the yield strength and, what has been recently brought to attention by industry, is any hardness values greater than 32 Rockwell Scale 'C' is a concern for critical equipment use subsea.

[01:15:05]

What BSEE and the team has also identified is that there are OEM quality control manufacturing process concerns. Various concerns in regards to if there are subcontractor vendors, non-compliance to the OEM manufacturing specs. Elaborating - some of the quality management systems only audit to the first tier subcontractor vendor, and some of the processes are subcontracted further down the chain to the second, third tier, and further down, vendors that may pitch foreign processes, such as starting from the original raw batch or there may be some concerns about the improper material casting, improper heat treatment, and there were also concerns about the latest edition - whether or not that was followed through for ASTM standard 2007. Prior to that, there was the coding standard ASTM B633 1998. This one had required a different type of material property value, which required subsequent heat treatment after the coating processes. After that the committee met in 2007 and there were different material property values that required a post vague after coating based on the material strength values. What was identified in this fastener failure, this was the second one, environmentally-assisted cracking was identified as the failure mode, due to hydrogen embrittlement, and there was a wide variation in the material property values ranging from 27 to 41 on the Rockwell Scale C. The failure mechanism is still not quite fully understood, as to where there was actual cracking before the manufacturing processes, the machining, or whether or not this cracking occurred during the actual service.

[01:17:15]

(I will attempt to use this prompter again. Eureka!) I will speak about this and then I will go back, if everyone will bear with me; so elaborating on some of the other known failures, as Troy spoke earlier, on the upper shear blade to Casing Ram Back Fastener failures, some of the key findings that was also a concern is the installation concerns - were the fasteners consistently applied in the right torque manner? Some of the fasteners were torqued beyond the material strength, the yield strength per the spec. Also, concerns about their appropriate lubricant, and again the heat treatment concerns of the actual fasteners. (Ok, I'm going to try and go back.)

[01:18:09]

(Ok, it looks like I went forward.) So, the October 2015 failure: what was identified for this evaluation 3 for the Blind Sheer Ram, again the failure due to hydrogen-induced embrittlement; high material hardness of the cylinder studs. If you can recall the picture that Troy had shown earlier, what was really concerning was there was a significant high hardness values of 41-42 Rockwell Scales 3, and I would like to elaborate again that this was a 41/40 alloy. Inadequate posts - they were not appropriately followed per the spec, so therefore there's concerns about posts breaking after the coating process. Hydrogen may become trapped in that initial layer and may expand and may contribute to the hydrogen-induced failure, so that is also a concern.

[01:19:13]

(Let me try and go back. There we go! Good job!) I tend to do by doing so I'm actually living up to being an engineer, I see. So going about the fastener failure one, what was identified was significant again material properties gaps. There was concerns about the hardness values beyond 32 Rockwell hardness C, some of the material properties were really, really high - high as 38 and these bolts were used for subsea service. There were coating concerns. There was an initial coating that was used subsea and there was concerns as to this coating may actually promote the release of hydrogen, and promote environmentally assisted corrosion cracking. Again expounding the broad range of the material property requirements among applicable industry standards, and there was concerns about Paul Lee management systems oversight and auditing control. The QMS system really only audited it down to the first tier, and as such, there was not compliance to the OEM manufacturing spec by some of the subcontracting vendors. There needs to be a better oversight of this. There was also concerns about the post-bake process was not followed. An older standard was utilized for this one - ASTM 1998 - and based on that standard, and based on the spec, the material hardness and the material yield strength was not required to do a post bake. Subsequently, there was a more recent addition, but based on that standard that was followed per the OEM spec, but a post bake really should have been applied after the coating process. The mode of failure was identified again. There seemed to be a common theme as a result of these material properties and the coating processes - no post bake, environmentally assisted cracking again due to hydrogen embrittlement and again, elaborating, there is a wide range of hardness values going from 34 to 38 Rockwell Scale C, but that is also per the spec.

[01:21:50]

Ok, so going to other known findings - the BOP Flange failure of June 2010, as Troy touched on. This was the one that BSEE had lately known, and I would like to also expound upon the colleagues that had spoke before me - this is a really, really great concern that there needs to be information and data sharing. Data sharing could help in trying to identify what's the best action plan and what's the best resolution. The alloy here was not 41/40. This was actually an Inconel 718. For those of you in the aerospace industry, you may be familiar that this is one of your common alloys that are used, however, this is not a known to be used in some of the oil and gas industry. The hardness value was 42 to 47 Rockwell Scale C and as a result there has been some updates to API industry standard, as a result of this. Again, hydrogen stress corrosion cracking and the concerns with the hydrogen being the by-product or the cathodic protection, which promotes the free release of hydrogen therefore defusing into the material substrate, becoming a trap, and causing the corrosion failure - the stress corrosion cracking.

[01:23:27]

So, as Joe mentioned, there is basically four areas of concerns that was identified. The first one, the design standards, what was identified is there are significant gaps among all the applicable industry standards in consistent requirements for material properties, and as a result there is a need to have harmonization among the requirements. The second one is manufacturing processes and procedures. Concerns with is there appropriate oversight with the initial raw material processing, the subsequent machining - this is one for further study, we would like to suggest for like further research, there may be concerns in regards to whether the threads are cut or rolled that could contribute to some of the fracture, the pre- fracture, of these bolts, and of course when the bolts are fastened and torqued beyond their yield strength, depending on the threads that can also play a part. Heat treatment, again if the material is appropriately heat treated and as all metallurgist know, you have to follow that TTT diagram - Time, Temperature, and Transformation. We'll have to thank our thermal instructors about it, but something simple, like just throwing something in the oven, you may think it's completely done and heated, but depending on where it is, within that furnace, it may not be appropriately cooked on the inside. I guess the best way I can describe it, you put a cake in the oven, you take it out and it looks like it is completely cooked, but if you stick a toothpick through it, you pull it out, you may have some goo in there, so even though, you may think that your bolt is completely heat treated appropriately, is the thermal coupled within the right area in that furnace? Is it appropriately heat treated? This may require extra time to actually take the bolt out and actually do cross section and look at the microstructure of your component to verify whether it's been actually heat treated appropriately, and, even before that, once the component has come from the raw material, do you have the appropriate microstructure? The phases can also be, not necessarily friendly sub C and, in the presence of hydrogen, you have the rapid fracture. Coating - are the appropriate coatings utilized? Some coatings may not be the best, ideal coatings for this service, and also is the coating post-fade processes? Are they appropriately done? Are they appropriately done immediately within that time duration as specified? Is that duration post baked long enough? I won't get into the details about painting, even although, after coating, that's possibly more in the weeds for like task groups, but that is also a concern that was identified - was those bolts appropriately painted all around? Is that the right paint? Is that the right coating? Etc.

[01:26:52]

Again, I guess I'm sounding like a broken record - quality control and auditing. There really, really needs to be better oversight and really auditing further down the supply chain, further past the first one, the second, the third tier, and further down the supply chain. Are they appropriately following the OEM spec? Are they appropriately following the industry standard? And within that, is there checks and balances to keep up with the latest industry standard? Is everyone on board? Is everyone keeping up to date, and how long is that time period to implement the latest industry standards within the OEM spec? And then again of those subcontractor vendors are they following the specification? Is there compliance? And again the management of change that's also a concern. And finally, the fourth area is the operational procedure, that is also a big concern. As Joe mentioned, you have this widget, but is this widget actually assembled correctly and is everyone following the same installation procedures? Are these bolts assembled in the right pattern as specified per the OEM? Torqueing - is the guns that, oh excuse me, guns, I was sorry, forgive me I can't help it, I've been around a lot of engineers and other people so I tend to speak more candidly, I apologize, but are the instruments that are used to install these bolts, are they appropriately calibrated to do the torque procedures? And cathodic protection - that's another area that really needs to be further explored. What is the appropriate applied current voltage system? Are the anodes replaced? Are they appropriately inspected when the stack is full? How much corrosion is identified in those anodes and, of course, you have the perfect storm, and I like to thank Trent for this, for reiterating this, you have your three circles - your environment, you have the load, and then you have the operation. Then finally highlighting on the operational procedures: In-Service Inspection - how frequently are we inspecting? Is each inspection being done on the same manner? How much detail is this? Are they being inspected? That is another concern, and what exactly is considered to be the appropriate data. Is some data just totally thrown out? On this I would like to highlight Dr. McNutt with some of the previous failure that was identified for the Concord. That little small debris from take-off was the one small component that played part in that disastrous failure. It could be one small thing that can throw the whole three circles out of sync. And of course we understand the need to understand the GNG condition. Where are these components being used? What is the salinity of where the components are being used? And, as Joe mentioned, some of these components are used globally, and then brought back on the OCS. Is there a proper in-service inspection, maintenance? Does that salinity of what these components have seen in other charted waters, does that play a part?

[01:30:31]

So, highlighting a little bit more on design standards, I would like to note that not all of the standards are listed that does have an impact. I understand of course some of these standards are different, versus production, versus drilling, and definitely understand that there is task force in different groups that are addressing these concerns. You have your API standards - API 6A, 16A, 16F, 17A, and then recently API 20E, API 20F, API 6A718 addressing bolt property requirement concerns, but there is significant material property gaps. They are being addressed, but what BSEE has identified, other than the first evaluation, is that there were different hardness yield strength value requirements for fastener manufacturers. The other industry standards realized that NACE is a very in depth corrosion standard, but they also do have different values and requirements. NACE MR0175, NORSOK M-001 would like to emphasize that they also have different requirements for fasteners that are used with cathodic protection. There were concerns with, as mentioned earlier, ASTM B633 with following the latest edition of the standard with 1998 versus 2007. 1998 had a different strength value of post baking, after 1100 MPA versus when the 2007 edition came out they required post baking after hardness value of 31. There was also some different requirements, don't quote me, but there was different requirements in regards to the post-bake duration between 1998 to 2007. There was also different requirements for the pre-bake, based on the, excuse me, there were different requirements for ASTMF1137 and ASTMF1941 for the post-bake versus ASTMB633. ASTMB850 is your post-bake standard. Again, stressing there is a greater need for consistent harmonized requirements among industry standards for fasteners that are used on critical components used subsea, and again stressing harmonization of the hardness, yield strength, ultimate tensile strength, the mechanical material properties, the coatings, and also the cathodic protection. Realize that these coating that have been utilized were essentially zinc chromate and zinc phosphate, but this is something for the industry and possibly the research studies to look at, exploring alternative coatings, like organic coatings. I won't throw out any names at this point, but I'm sure some of the tech experts understand where this is going.

[01:33:59]

There is really a significant need - I can't emphasize this enough - for quality control of the fastener manufacturing processes and the material properties for critical subsea applications these equipments that are being used. Some design factors, as I mentioned earlier, the three components that do play a part in the performance reliability: the environment - what these fasteners are incurred and experienced under fatigued loading - and the raw material selection. These processes and procedures would also need to be further looked at and what have the impact is the casting of the raw material, the machining processes. Are there appropriate machining processes? Are they calibrated or are they followed? And something to add is the role versus cut threads - the heat treatment processes. The goals from the beginning, if these fasteners aren't heat treated appropriately, then they have a different result in material property values and that goes back to the supply chain, making sure that these sub contracted vendors follow that spec and heat treat appropriately. And, again, the coating processes - is the appropriate coating used and such are they being post-baked? And the cathodic protection also should be further examined. So, again just emphasizing, there are concerns with auditing only to the first tier of subcontracting vendor. There is concern with sub contractor vendor that are performing these different processes. Again, keeping up to date and following the use of older standards and when are these standards being updated, what is that time duration, and what is the legacy for these latest standards being implemented into the OEM specs.

[01:36:13]

Operational Procedures. Fastener installation. This impacts the equipment reliability and performance. Is the equipment assembled appropriately? Is it being followed through the required torque procedures? Is the pattern being performed in the installation consistently? Is their appropriate lubricant being utilized per the specifications? As everyone knows there are all kinds of lubricants that are being used, you have your moly coat etc. but if in the interest of time if there is another lubricant that may also be a concern and is the torque gun calibrated appropriately?

[01:36:56]

Fastener inspection. Are the BOP fastener inspections done on a periodic basis? As Troy mentioned, there happened to be identified of a fastener failure issue when the BOP was brought to stack in between well maintenance inspection. Should we start inspecting a little bit more frequently and, if so, how many fasteners are being inspected when its being brought to stack. Is it just one or is it all of them? This should be considered. And are they also being replaced when that stack is being brought to surface? Cathodic protection - that is something that still needs to be further explored and really fully evaluated. This can possibly contribute to the fastener corrosion and degradation - if that system is not in sync and aligned, if that sacrificial anode is completely gone, you have the more promotion of the corrosion degradation acceleration. I won't get into the science of it and the kinetics and fixed law of diffusion of the hydrogen ion defusing into the substrate of the microstructure and the difference between a BC structure and the FCC structure and how the hydrogen can get entrapped, and then we have a big crack. I won't get into that, but I'm sure the metallurgists understand the impact of that. And, I'll turn it over to Doug.

[01:38:28]

[NEW SPEAKER - DOUG]: Thanks Candi. Let me summarize Session 1. We have identified, we believe an industry wide issue, involving fasteners. It involves different components and different manufacturers. We have nine different areas of concern, or areas for improvement. It includes metallurgical properties, quality assurance processes for manufacturing, cathodic protection, inconsistent industry standards, coatings, installation procedures, inspection protocols, and design improvements. Furthermore, we're hampered by the lack of data sharing. I think the director mentioned we're aware of failures going back to 2003 but we don't know how many. As I mentioned, we have multiple parties involved, and there's legal and commercial issues that prevent data sharing but that's definitely an area where we need to improve. The Well Control Rule does provide for mandatory reporting but that only applies to US waters - it would not cover failures that occur internationally and, in addition, I think the director mentioned this also - one manufacturer believes that this issue might impact onshore operations in pipelines, so there is a need for comprehensive industry-wide data sharing program. Now with that, I'd like to make Joe, Troy, and Candi available for any questions. Go ahead, don't be shy. There's one back here.

[01:40:41]

[Question from audience]: "I was wondering if the incidents of these bolts failures, and the use of higher strength bolts corresponds with going to deeper and deeper well sites. Has there been a change of materials used since say 2000? I see Inconel being used, which is somewhat unusual, but has 4140 been the standard for a long time?

[01:41:24]

[Candi responds]: Again, it’s too simple for me, I can do a fourth order nonlinear homogeneous equation, but the simple on off switch. Typically, it has been 4140, however, for strength for certain components like the bind sheer ram needed a stronger alloy so, in unique situations there has been the Inconel 718, but typically it has been 4140.

[New speaker - Doug]: Any additional questions? Okay then, time for a break, let's take a break, remind everyone that there is water in back. There's vending machines down one floor. And, we'll take 10 minutes and come right back.

[New Speaker - Joe Levine]: Let's come back right at 11:00. We'll give people plenty of time to network. I know everybody loves to network, so we'll see you at 11:00 and I start on time.