Panel No. 4: What real-time technologies are available to measure the "health" of BOPs in service and aid in the detection and response to "kicks?"

Moderator: *Pisces Carmichael, Project Manager, Lloyd's Register*

- *Garry Davis- Group Manager, Center of Excellence Well Control Equipment, Moduspec USA*
- *Mr. Fereidoun Abbassian, Vice President Wells Technology, British Petroleum*
- *Frank Chapman, President, Ashford Technical Services*
- *Tony Hogg, Director of Subsea Engineering, Ensco*

>> Ok, let's get it started. Welcome back from lunch. This panel is going to discuss the following question: What real-time technologies are available to measure the health of BOPs in service and aid in the detection and response of kicks? The moderator for this session is Pisces Carmichael. She's the SEMS product manager for Lloyd's, where she is currently leading several major teams. She has 15 years of experience in safety engineering, system auditing, and equipment design. She has a bachelor's degree in electrical engineering and a master's degree in safety engineering. She is a member of a variety of industry groups including the Center for Offshore Safety Audit Committee, API and ASSE. Thank you.

>> I want to thank you on behalf of the panel for coming back after lunch and We hope to keep you entertained and awake. There are some snacks in the back I see, so hopefully that will help as well. I want to thank BSEE for the invitation to be here today and Doug for the introduction. We have a good group in panel four where we will be discussing real-time technologies available to measure BOP health as well as kick detection and response. Our group consists of -- we have an operator, we have a drilling contractor, we have operational integrity engineering and consulting as well as software development represented on our panel. So we'll go ahead and get started with Mr. Gary Davis. Gary is the global manager of the Well Control Equipment Center of Excellence at Moduspec, the leading global experts in innovative services designed around people, systems, and equipment to assure operational integrity. Mr. Davis has a background in the electro mechanical design and has more than 16 years in upstream and downstream subsea experience. We welcome Mr. Davis. [applause]

>> good afternoon and I would like to start out my presentation by thanking BSEE for facilitating the meeting today and a special thanks to Sharon who has over the last two weeks has really worked very hard to make sure everything came together for today's event. Basically my…[applause] yeah. My presentation today is based on technology demands from the industry, what is being asked post-Macondo to help mitigate losses in the industry, to help mitigate some of the issues we have been faced with over the

last 24 months. The question came to Moduspec and Lloyd's quite simply. How much of a leak of BOP is -- would constitute a degradation in reliability that would force the stack to come to the surface for repairs? And the response was simple. How long is a piece of string? The reason this type of response is warranted is because these systems are very complex and are designed in such a way that redundant capabilities are built in. And the assessments that were being undertaken had as many of my colleagues this morning mentioned had not been taken into account, the capabilities to mitigate loss and maintain its reliable status in some cases had not been taken into account. Our agenda for today is the challenge which I've just spoke of. The solution which we and the industry have worked together to come up with. The analysis it's undertaken to build such a model. The model itself. And defense in depth, which is user interface, which is the application that goes into the field for our individuals, and the continuing benefits. The challenge was to develop the capabilities based on input to assess risk and reliability instantaneously and communicate to all interested parties effectively and that is very important to point out, the communications portion of this. To date the industry has multiple ways of providing information to the regulators from the drilling contractor, to the operator, and then to the regulators to be able assess this information in such a way that all parties can come to an agreement on the decision that has to be made. Which is either to pull the stack or leave it in service until such a time as you could safely secure the well. Of course, as I spoke of, an effective way to communicate this risk assessment, how we evaluate these losses or how we communicate each failure in a subsea BOP and how that information is communicated across the board to try to standardize how we communicate from drilling contractor to operator to operator to regulator. And account for the full capabilities of the BOP - this was very important for us to be able to take apart the BOP system and it controls in all of its complexity and make sure that each portion of the system was accounted for in this assessment, to understand that its full capabilities and be able to report it effectively with the communication. The question was quite simple. When does a failure or failures affect the reliability functional levels such that continued operations cannot be maintained in operational circumstances it is intended to perform? The BOP risk modeling is built in a software package that has typically been used in the nuclear industry. So this is where we have taken technologies or initiatives outside of our industry and tried to incorporate them. The risk spectrum is used in 53% nuclear facilities to do just what is in here in our industry today. The model that's built into the software has to be customized for the BOP that it is intended to operate under or report on. The risk spectrum model – modules, excuse me, they utilize block diagrams to demonstrate the connection, the interconnect ability between the assembly, the systems, and the components. The fault tree analysis is a logic application, how we access this information once built into the software. PSA is a suite of softwares that brings this information together. And then the FMEA -- once the model that has been built, we go through a FMEA process, or a very similar FMEA process to validate and verify that what we have come up with is in fact accurate and acceptable by all parties. And then risk watcher is the dashboard or defense in depth, what I'll show you later, the dashboard in which the operators will plug in their failures and the model will assess it and give them an output. The result is the instant display of revised risk levels for all stakeholders and regulators and a reliable, standardized way of communicating. And that's what we're really trying to get to. We want to assess these systems with all of their technical content and be able to transmit that information effectively and uniformly from one party to the next so all parties understand the risks that they are evaluating at the time that they are evaluating them. This exercise is very important because the typical time for this assessment to take place is sometimes hours or even days. The risk model having done this exercise up in the front and having to assess the system in such a way, in such a way that everyone can see and challenge the model greatly reduces that time for communication in decision making. Basically, we take it apart by system to upper level components to sub components and sub-sub components, which is basically the reason I put in this slide just to show you how we start out by looking at the very simplest of information first. Ah-ha. The next thing we do in this initiative is we build block diagrams. And as you'll see, each of these blocks are colored green. In an actual application, which this is reflective of, each of the green blocks actually clicks into another field of equipment or sub equipment that belongs to that top level assembly. After we have finally built our block diagrams and all of our associations between systems, components, and assemblies, then the information needs to be put into logic to make sure that we understand there is a minimum bar that this stack must not fall below in order for its reliability to stay in such a state that the equipment can stay in service. And this is a real simple depiction of how the information is assessed and pulled together. Basically, you have a stack, we have taken all of the top level components and then we've assessed them through their circuit affiliations and their component by component failures. What we have typically done is a very simple exercise, and it's an exercise that we've done in this industry for a long time. This is a component, this is what has failed, this is what is affected, and this is what remains intact to mitigate a loss or maintain a safe and reliable operation of the equipment. We do, in fact, analyze the entire BOP system and its controls. Examine how a fault affects its redundancy or reliability levels. The analysis that takes place is what goes into and builds the model itself. The model can now be and has been interrogated by industry experts. After each model is built, the opportunity for us to go through do that FMEA and make sure we go through every single component -- that is what has failed, how it affects the system, and what remains in the system to mitigate the loss -- but like I said, there are minimum requirements. The emergency functionality of the stack can never be deterred. And that is the portions of the system such as the dead man and auto sheer circuits. Basically we've broken it down into four categories that's recognized by the industry, which is red, of course, meaning unacceptable risk, orange being high risk additional assessments necessary, moderate risk meaning redundant capabilities are still available and maintenance is required. And low risk meaning that full system availability is a –or the full system has its availability. Basically, this is the interface.

What you are seeing here is a defense in depth. The top bar--I do not know if we have a pointer -- but the top bar in this particular screen is the overall health of the BOP system. And each of the subtitles that you see under that are the system as it breaks down by assemblies and sub-assemblies and sub-sub-assemblies. As we go through, I am just going to -- I got my two-minute mark – I'm going to quickly go through this. This is what it would look like as you input failure into the system. You get a read back that basically says what system has been affected, what component is now out of service, and as you did degradate that down further in the case of a critical component or major components on the BOP, you notice that the stack, status of the stack turns yellow meaning that you are down to a level of redundancy that will require maintenance on the next stack retrieval. Once we have degragated down to the point where we get orange, meaning that an additional risk assessment must be undertaken, this is where we take into account the variables. The variables in this case would be where we are at in our well program? What are the environmental concerns? What are the operational concerns that may affect this decision? It means that we are more than likely on a top level component down to a single point of reliability, and redundancy has been reduced. And of course, once the stack falls below that minimum criteria for safe operations, the model will automatically say or indicate that the stack must come to the surface for immediate repairs. And basically, the continual benefits are the instant verification of new risk levels by all stockholders and regulators. The BOP, even though independent individuals may not be present during the actual inputs or the assessment of the system, the evaluation was taken care of or undertaken by people who are not stakeholders with any particular venture. Another very, very important continual benefit of this particular project is its after benefits to the industry. The way that this information is taken apart with its fault trees and block diagrams, it immediately shows personnel in the field who are doing these exercises the association from their equipment to their systems and their circuits they're attached to, which gives them a point of verification and allows them to go back to their system and insure that their findings are 100% correct so it gives them that little edge to ensure that the examination has been thorough and it's complete. Thank you very much. [applause]

>> Thank you, Gary. Wonderful job. I think your presentation kinda tied into the complexity that Chuck mentioned during the GE presentation and rolls us into looking forward and looking at things that we can do as an improvement going forward. So, next we have Dr. Fereidoun Abbassian. He's the vice president for wells technology with

British Petroleum. He started out as a mechanical engineer, after completing his Ph.D. in structural mechanics at the University of Cambridge. In 1996, he transferred to Houston and began to be in the development of the Gulf of Mexico deep water strategy within BP. He later did work in Angola and is now based back in the Houston area. So let's welcome Dr. Fereidoun Abbassian. [applause]

>> Thanks, Picies, for the kind introduction and good afternoon, ladies and gentlemen. On behalf of BP, I would like to thank -- is the microphone working? I need to get closer. On behalf of BP I would like to thank the BSEE for the opportunity to participate in this forum. Today, I would like to highlight three recent efforts in BP which aim at enhancing the safety of our drilling operation through use of real-time monitoring capabilities for safety critical equipment and safety critical operations. So, the three efforts that I would like to highlight are the development of capability for real-time BOP health monitoring, remote BOP pressure testing and establishment of BP's Houston monitoring center. The first two are efforts which are currently in piloting stage, and the third effort, the Houston monitoring center, is well established and has been up and running since July 2011. Let me start with the first of these three efforts. Over the last 18 months, we have been developing capabilities for real time BOP Health monitoring. The aim is to simplify and broaden the reach of BOP control diagnostics beyond the rig sight. Currently, BOP diagnostics that contain thousands of alarms is not brought back to shore. We did mention transparency earlier this morning. This system really attempts to make the diagnostics of the BOP more transparent. So, we believe that the capability really improves communication and will aid in decision making process. So the system as you see on the right-hand side of the slide provides, at a glance, a display of all of the pertinence -- pertinent BOP health information. [Clears throat] Excuse me. At the center of the display and towards the left, you see a traffic light status on the availability of key functionalities in the BOP. That includes availability of sub-sea BOP elements -- that is rams and annulars operated from either blue or yellow part -- availability of surface systems including power supply, control panels, PLCs, as well as the availability of emergency systems including emergency disconnect and emergency high- pressure shear. The system also displays BOP element health history along the top as well as a history of valves position to the right hand side of the display. So, this provides capability to review, if you like, whether any valves have been opened or closed or whether there has been an alarm over a period of 24 hours. So, last year we partnered with NOV and Ensco to pilot the system on DS4 in Brazil. The system has been up and running since February of this year, and we believe this is an industry first. We talked about collaboration this morning -- this is a great example of collaboration between an operator, a drilling contractor and an equipment manufacturer. Our first installation of the system in Gulf of Mexico will occur later this year on Ensco DS3. We are also

working with other equipment manufacturers on similar systems to be able to extend a reach of the capability to all our deepwater rig fleet. At the second real time capability that I would like to share with you is remote BOP pressure testing. Currently all BP rigs operating in Gulf of Mexico uses an offshore based system to digitally interpret pressure -- BOP pressure test data. The remote BOP Pressure testing is to provide an independent means of witnessing the BOP Pressure test from onshore. So the system digitally interprets the pressure test data directly by accessing the data from mark system – BOP mark system – as opposed to the data coming from the seaman unit, and in doing so it eliminates complexities associated with choke line temperature effects. The system also sensors BOP, the position of BOP elements, and provides a direct confirmation of the actual pressure pass. Essentially what component of the BOP is actually being tested. So the system has got -- has been designed in a way to minimize human factors in interpretation of BOP test data. So, we successfully demonstrated the system, an early version of this system, by streaming real time BOP pressure test data from the seaman unit on West Sirius rig in April of this year. And we brought that data on shore and the processing of that data was done on shore in real time. The next stage is to pilot the final version of the system which will use BOP marks data, directly using BOP pressure, or pressure in the BOP cavities, and that will occur later this year on Ensco DS 4, followed by installation of the system in Gulf of Mexico on Ensco DS 3. We are also planning to extend the capability of case -- you know, digital pressure testing, to casing pressure testing in 2013. BP Houston monitoring center is the third of the real time capability that I would like to share with you. HMC enables a 24/7 monitoring of well parameters from onshore. Essentially the data that is available to the offshore personnel is also available in the HMC Environment to the staff working within HMC. So essentially, HMC provides an additional pair of eyes to monitor well parameters. It staffs 30 specialists, full-time monitoring well parameters, and specialists have got extensive experience in deepwater operation with relevant key stills in well bore monitoring. The center provides a constant communication with offshore rig teams. It monitors real time data. The real time data that it monitors includes hit levels, flow in, flow out, standby pressure, mud weight, and you know, the typical mud logging data. The center also utilizes standardize processes and procedures which have been derived from best practices across of our deep water fleet. So accountabilities are very clear within HMC, the control remains at all times offshore. The driller has got primary accountability to monitor the well. We also have processes and procedures for escalating if any observed parameters fall outside defined and agreed range. And those processes are followed and usually leads to consultation. And if there is any need for escalation, the procedure is very clear. HMC, as I mentioned earlier, it has been up and running since July of 2001. The focus of HMC has primarily been on well control, however we are extending the capability of HMC as we gain more experience in the use of such real-time environment to other safety protocol operations such as cementing and also pressure testing. So in summary, let me reiterate the three real time capabilities that I shared with you. First, real time BOP monitoring, the aim of this capability is to simplify and broaden the reach of BOP health diagnostics beyond the rig site. Make the system more transparent. Second, is remote BOP pressure testing which provides an independent means of witnessing a BOP pressure test from onshore. Again, when that capability is field tested on DS 4 that will be a first, an industry first. Last is BP's monitoring center which enables 24-7 monitoring of well parameters from onshore. We believe all these capabilities help enhance the safety of deepwater operation and that is really want I wanted to share with you. Thanks very much for your attention.

>> Thank you, Dr. Abbassian. Next we will move on to Dr. Frank Chapman. He is the president of Ashford Technical Services. He co-founded Ashford in 1989 and worked on the development of a number of systems for controlling and monitoring equipment in several industries, including petroleum, semiconductor and telecom. Before founding Ashford, he worked with FPS and Kellogg Round and Route, where he developed structural analysis software for early offshore production platforms. Dr. Chapman has a B.S. from the University of California at Berkley and a Ph.D. in physical chemistry from the University of Michigan. Let's welcome Dr. Chapman.

>> Thank you, Pieces and thanks to BSEE for the opportunity to come here to speak today. So what I'd like to talk about is offshore BOP monitoring using today's technology and going beyond today's technology as well. So let me start with a brief summary of Ashford's what we call rig watcher BOP monitoring system where we sort of focus on proactive maintenance, early identification of problems, providing guidance to guys on the rig from folks onshore and follow that with a summary of our experience over the last three years. Lessons learned, feedback from users, some of the insights we have had, and lastly, indicate the big picture where this might actually take us in the future. So let me start here with just a big picture of how this thing works. Starting over here with the rig on the left and we'll walk sort of counterclockwise around the slide. On the rig we collect data from various sensors, pressure switches, solenoids, pressure transducers, flow meters, what have you, we get that data off -- that raw data off the rig to a secure server on shore where we turn that raw data into useful information and present that back to the user via website and then completing the circle. That gives the user the ability to look not only to the current status of the BOP, but look at some historical information as well. I think the key thing right there is the anytime, anywhere, a lot of times the most experienced guy is not on the rig, but if he has access to current information he can help troubleshoot problems taking place. So, we'll look at three or

four slides here. I want to give a flavor of the kind of information we have been collecting. Let's start with, with sort of a preventive maintenance slide, tracking usage. What we are doing here is tracking the usage of the equipment in terms of the number of times the equipment's been cycled. This is a report for the upper annular listing all the different valves that are associated with opening and closing the upper annular. The cycle count in that fourth column there -- what we're gonna talk about a little later is moving from a time-based maintenance regime to a cycle-based maintenance regime, so you can see the cycle counts. Then the fifth column is sort of interesting question, you know, what is the expected life for some of these valves and some of these components? There's not a lot of real good information out there, so we've got a placeholder. I think part of the takeaway is as this kind of information is gathered the industry needs to correlate that with maintenance and actually have a better idea as to what the expected life is in terms of these components. So, moving on real quick here, this is sort of an overview of operations, tracking operations. This is the bar chart here that pretty much summarizes for a 24-hour window what's been going on with the BOP. Each one of those bars represents one of the major components of the BOP. So, the first bar on the top there is the upper annular. The color coding corresponds to the driller's panel, green being open for the annulars and rams, red being closed. If you go down to the middle of the slide you'll see a yellow and blue one, that's the pod select. At about 4:00 a.m. in the morning, they switch from the yellow pod to the blue pod. And a lot of this activity, at the bottom is the choke and kill lines, a lot of this activity is associated with pressure and functional testing corresponding to that pod change. The next slide is something similar to that. I just want to emphasize the fact – well first of all it's obviously presented as a web interface. This is a partial day about -- this is a screen shot taken about 3:30 in the afternoon. The gray on the right-hand side is of course the future. And we're about 15 seconds behind the rig. That's the lag time associated with getting the data off the rig and turning that raw data into useful information and presenting it back to the user. Looking at some of the hydraulic pressure kind of information that we collect here at the top is another one of these -- we call them control charts. It's the upper and lower annular and the four rams. You can see they were doing some, probably again function pressure testing here. It's a one hour window. And then down at the bottom of the slide you see the – that's the read back, manifold read back pressure. And you can see every time one of the functions is opened or closed we get a spike in the pressure here. We've also got the ability to look at these pressures -- profiles I call them, time versus pressure, at a much higher resolution, about a 90-second window corresponding to one of those transitions there and then using that as a way of characterizing some of the details about the actual transition.

So, you know we talk to people about this; this whole concept of black box always comes up. They ask, you know gosh, what you guys have is a black box. And indeed, that's the case, but it's important to realize the black box is something that's used for forensics after the fact. You know, for finding the root cause of a problem after it's actually occurred. We want to focus here really on, you know, using it as a tool to review and monitor the drilling and safety equipment on a regular basis, identify problems before they become critical, help transfer knowledge from the guys that are onshore to the people on the rig, view operationals on a regular basis. The goal here is outlined in the third bullet there, basically, proving operations, increasing safety, reduces the need, hopefully, for the black box.

These are some of the objectives that we use when we initially laid out the design of our system. This whole idea moving from time ba – time base-- to cycle based maintenance. We can now do that because we can now collect that data about its actual usage, the cycle counts. You know, time base is fine for equipment that's used in a very regular pattern, say for example, a pump in a processing plant. And yet, the BOP is an interesting device. It sits there most of the time doing nothing, accumulator bottles all charged up, and then boom, a signal comes to close a ram, and a lot of stuff happens to a small piece of the components of the system over a very short period of time. So it's really better to characterize in terms of a cycle based maintenance paradigm. And so part of that sub-bullet there, we can begin to gather information about what the actual life -- useful life cycle is for some of these components. We are looking at developing some metrics using to identify potential problems before they become critical: looking at pressure versus time profiles, looking at flow versus time profiles in those very detailed, 90-second windows where the action is really taking place. And using those pressure or flow profiles to develop metrics which can then be looked at over time to identify subtle changes in the performance and behavior of the system.

Last major bullet there, it just emphasizes the fact this whole monitoring business is sort of a three -- three-part problem. There's acquiring the raw data. You know, we've been doing data acquisition for 50 years now. That's not to say that new sensors and things aren't going to come on line. But that's not really where the major problem is today. And storage is not a major issue. We have multi-gigabyte the hard drives; we can store this data. It's the last two bullets that are really critical, I think today and that's, you know, getting this: analyzing the raw data that comes back from the rig, turning that into useful information and presenting that back to the interested people so they can quickly understand what's going on on the rig and, and hopefully identify problems before they become critical.

Let me back up one minute, the, the key bullet here is at the bottom: common information format so. Here is where that becomes a problem. And this is sort of, you know, my idea of where the future is for this. We have on the left-hand side sort of a mixed bag of rigs. We have jack-ups, we've got semis, we've got drill ships, we've got surface BOPs, we've got sub-sea BOPs, we got fully hydraulic control systems, we got mucks control systems. You know, we’ve got equipment from a whole variety of different vendors. But at the end of the day, it's a BOP. And at the end of the day, you ought to be able to that convert that raw data from any one of those systems into a common format stored in the middle of the slide there and then on the right-hand side be able to take that common information and present it back to the user in a standardized format, so that no matter what rig you’re looking at, it looks pretty much the same. Again it's a BOP, folks.

So, something for everybody here. You now, this is sort of in the spirit, I guess, of open, transparency, sharing of information about the various different stakeholders. Let everybody sort of share in that information. So the biggest – you know we think with the kind of things that I just showed in the last couple slides you can get this standardized format out there, then one person ought to be able to easily monitor multiple rigs on a fairly regular basis. The biggest benefactor of all this is of course the drilling contractor, preventive maintenance, monitoring and improve operations, provide experts’ guidance to the guys on the rig. Again the guy with best 30 years of experience probably isn't on that rig. Operating companies don't really have direct responsibility for the BOP, but you know they are responsible legally in most cases for safely drilling the well. So you know, maybe it's a good idea for them to occasionally take a look at what's -- how the equipment is being maintained, how the equipment is being used. And lastly, the regulators who are tasked with you know effectively ensuring the adherence or regulatory requirements something like this gives those guys with limited resources a capability for actually implementing that. I thank you very much. And I look forward to your questions.

>> Thank you, Dr. Chapman. And last but not least we have Mr. Tony Hogg, director of subsea engineering for Ensco. He has – Tony has more than 30 years in international subsea work, including working for drilling contractors as well as the deep coal mining industry in the U.K. He joined Ensco with the acquisition of Pride last year, after working with Pride since 1999. Tony has been involved in several joint industry activities, including five API committees, and he's currently chairing the impending rewrite of API RP 64. So, let's welcome Tony Hogg.

>> Thank you, everybody, for staying around to listen to me. I think you'll find a lot of what I say a follow on from what Fereidoun told you. It's part of the same initiative. It's just more from the operator's -- sorry from the contractor's perspective rather than the operator's. Whoops. Too much technology.

The question's what real time technologies are available to measure the health of the BOPs in service. For me the easiest way and the best way to monitor the health is by the guys onboard the rig. And a lot of the discussions we have had today have talked about the redundancy of the equipment on the BOP itself. Nobody's mentioned the redundancy of the control panels and opportunities we have from the rig side. PPI there's at least two fully redundant control stations on the rig, one of them is in the drillers house, the other's in the tool pushers or on the bridge or somewhere in a safe area. But there's two fully redundant places to function everything. And on conventional systems there's also the HPU. And on the Mox systems you've got the event logger, which allow a third place to monitor the health. May even be just a pump running can alert an experienced guy to an issue. Looking at these panels and the information displayed on them can quickly guide them to what the issue might be. Competent crews -- there's no substitute for competent crews, not in any discipline. The industry has lost a lot of experience over the last years and we need to get it back. But there's no substitute for time to get experience back. I talked with somebody earlier saying, you know what's the substitute for 10 years' experience? It's 10 years' experience. There's – We've got a big gap in the industry. I thought I was old with many years, but listening to everybody here I have less experience than you all. There is a huge gap behind us to the people who are coming through. So any support we can give the guys on the rig obviously improves the benefit for everybody. So the ability to be able to display the information on the rig is -- it's incredible support. It's an incredible crutch for the guys. You've seen this before. It's virtually the same one that Fereidoun showed a few minutes ago. This is the top level edge. This system we have, lots of green lights there. Actually, you see one yellow light. That tells us there was a small problem. You can go deeper into these pages and see what that problem was. And matter of fact, this one here was sort of them starting up the drill, we got a lot of vibration, and it created a momentary error on the riser angle monitor. So it gives a flag. It's something that happened. You need to understand what happened to cause it. It doesn't hurt anything. But you need to know what it is. It flags, and you go deep into it to find out exactly what it was. There's many layers to this. I haven't shown them all. This shows the surface system. Everything here is fine. You can see very quickly it shows all the components exactly as you would expect them to be while you're drilling normally. This is the lowest stack. Can you see the connectors locked? Everything else is in order. We have mentioned many times today that the vast majority of the time the stack does nothing at all; it just sits there and hums away merrily. And this is what you want to see. This is what you do see for the vast majority of the time. Everything is good. The big benefit of this is -- actually it's got many benefits of course, but one of the benefits is if a guy on a rig sees something on this he's not seen it before, as I said we have a lot of experience out there but we still have young guys going through and if there's anything he's even unsure of, he can call somebody and they can look at exactly the same information he's looking at and help him to fully understand and deal with it. This shows the read backs -- this is the pressures that we select. This is the pressure we want the various components to see. And it also tells us the pressures we do see. Fantastic tool. Fantastic tool for surveillance and inspection and support. I actually thought that Fereidoun would have shown all of these slides, which is why I didn't put any more, but this is being developed further, we're – we're not ready to release some of it yet, which will show all of the cycle counts and the fingerprinting of solenoid valve operation and the history of all the components within the system. But, you can see from this and the other presentations you've seen from my colleagues here, we are all driving in generally the same direction and I have little doubt that eventually they'll –they'll all pick up from the benefits of each. The beauty of this particular one is that it's live today. We know this is-- this works. The screens I'm showing you are actual screen from this rig, from this particular rig. It does work. And it's going to get better. Short and sweet I'm afraid. That's all I've got. Thank you.

>> Thank you, Tony. So I think we have -- we definitely have time for questions. So, just to run back through. Gary, discussed the Moduspec risk model. Dr. Abbassian discussed the BP monitoring center. Dr. Chapman discussed the rig watcher. And then Tony went over the Ensco BOP Dashboard. So, we will take questions from the audience. If you want to stand up, we can recognize you. Yes, sir.

>> Thought you were going to get away? This goes to the panel. But as my role in API, and I look at this which presenting today and my question is which API document, if any, do you foresee the guiding document as far as standardization goes? When I was watching the presentation, I got to thinking about 53 and how we're required to test and verify the equipment reliability and so on, so forth. So I was trying to keep this in context of that mindset. So my mark on effect was ok, does this go into API 16-d, which is a control systems? Or is this like an add-on type system that's a stand alone? Do you see where I'm coming from? I'm not understanding how do I-- from the API side, how will we measure the success of this thing? How do we validate it?

>> Was the question directed at anyone or? Well I guess I'll… Question… while we are evaluating any particular BOP or control system of course API, industry recognized specifications and regulatory considerations are all taken into account during that assessment. I don't know if that is a direct relation to your question or not, but, yes, API is in fact accounted for in that. And some of the recognized practices are -- which apply to any one BOP. Of course every BOP is a custom model of a base model of some sort. So of course those considerations are ---

>> Yeah, just a little bit more clarification. Tony's been working with me on 53 for a while. I'm going to go specifically to Tony. Tony, you know what we -- the trials and tribulations we have been through and all the discussions and how we do the maintenance and testing and verification. All these operations and I'm trying to get an understanding of this, how does this kit fit into that bigger picture? Catch me now?

>> Yeah, yeah, I think it will fit into 53, Frank. I'm pleased you just finished the current version so we have some time to get it right. I think it's going to be very difficult to, to, legislate is maybe too strong a word, but to legislate a new product. I think it has to find its feet and find out how it develops from each of these initiatives. Before that, you can put a box around it. But, eventually, I would see it in 53.

>> Maybe, Maybe let me address a slightly different problem here that's associated with that. It's sort of, it's alluding to my last, next to last slide there, where we're starting to standardize this across a wide range of rigs. We have this standard, I think it's called WITS, well information transfer standard, which really focuses on well parameters. You know, I think we are going to need to have something similar to that, but, that's, it'll focus on the equipment parameters, if we are going to achieve a standardized presentation that allows people to, you know, look at this across multiple rigs. Thank you.

>> Just, just one comment. Whether it is going to sit within 16-D or 53, I think monitoring is a component of maintenance, very closely linked with maintenance. And I think there is an opportunity for standardizing the requirement for monitoring as it was -- opposed to what the screen would look like. I think there is an opportunity to come up with maybe minimum requirement for real time monitoring of BOP, sub-sea BOP system.

>> The panel topic included technologies, real time technologies for kick detection. Does anybody have anything to report on that area rather than specifically in BOP Monitoring?

>> Well, the focus of this session was obviously on BOP and real time monitoring as pertain to BOP, but there are efforts within the industry on improving capability to detect

kick early. And you know one such focus is in the area of better metering of what goes in and what comes out, essentially better flow metering, that I am aware of. And of course there are opportunities to, to, developing a means of analyzing the modeling, real time monitoring data we saw an example this morning. So there are a number of opportunities out there but a huge focus at the moment on improving essentially the flow meters we have at the rig site. So that is one area of focus that I am aware of.

>> Ok, I will ask one question to the panel, and that is what specifically can your individual industries, so as a consultant, as an operator, etc., what can your industry do to help push along the progress of these example models and monitoring that you showed here today, so for instance, what can be done to help push that along, to help encourage not only within your company, but even amongst your competitors maybe, to just push that real time monitoring along and encourage its development?

>> Somebody said earlier that one test is worth a thousand opinions, so I think the best thing we can do is get these systems on the rigs and develop them, test them, make them work and let everybody get comfortable knowing that they do work correctly.

>> Also I would add to the question it's very …all of the interested parties, including the regulators, come to some consensus as to what the requirements are, what's the criteria for monitoring and come to an agreement how we're going to do it and how we're going to assess the information and what actions are going to be driven from such a software. It's very important for us to look at potential unintended consequences by automating such a system as well control. So, it is very important that we have the interaction of all—of all parties involved with this type of decision making.

>> I would echo what, what you just said. I think collaboration is important. What I had described was an example of collaboration across three parties. We certainly in BP look forward to any opportunities that we -- we have to closely the work with industry and also with the regulators to, to extend capabilities such as, such as the one we just described and the one we have successfully implemented on Ensco DS 4, and we plan to implement it on a number of our rigs in GOM and elsewhere.

>> I guess, hello, the only thing I would add to that, is I think it's – you know, we have a lot of data coming from well parameters. Now we are talking about adding data coming from monitoring the equipment. Someplace all that needs to come together to give us a complete picture of what's going on on the rig, with the well, with the equipment. And that's a pretty big integration problem. But, I think it needs to take place at some point.

>> Tony, did you -- are you just taking better advantage of the existing instrumentation? Or did you install additional instrumentation on the BOP?

>> We actually took advantage of the instrumentation, the sensors that were already there. We did add some pressure transducers, but a lot of it, the pressure switches, solenoids were already in place.

>> The system we have got on essentially transmits the information from the event logger, puts it under the GUI, the graphical screen that you saw. But in the background you can sort data, you can take advantage of the numbers behind the pictures, if you like. But it's the existing information; it comes from the event logger as is.

>> Panel number four. Any more questions? Ok. Thank you very much. [applause]

>> Let's take about a five or 10-minute break here and come back and finish off with the last panel.