FPSOs Present and Future Workshop

Minutes

Session I
Panel of Invited Speakers
June 7, 2000

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Minutes of Session I: Panel of Invited Speakers

MR. WILBOURN: Thanks, Skip, and I'd like to begin by thanking the members of the industry that volunteered to serve on these panels this afternoon and tomorrow. In the process of calling, I guess the success ratio was maybe one out of five that had the time to do this. Obviously, everybody is very busy. The best I can determine, everybody's doing three peoples' jobs today. So I appreciate you taking your time to help us with this workshop. A couple of things. We're going to try to cover policy matters today and technology matters tomorrow. So if you keep that in mind, that's sort of the demarcation of the way we've got the workshop structured. As I was talking to a lot of you about attending the workshop and participating, I guess the one question that kept coming up is: What is your real purpose? What are you all trying to do with this workshop? It reminded me of a cartoon I saw in a magazine a few years back and it was a picture of a conference table with a person sitting at each end. In the middle of this conference room table was a bowling ball and -- it looked like about the size of a bowling ball and it was half black and half white. And the caption of -- the black half of the ball faced the person on one end and the white half faced the person on the other end, and the caption stated simply, "It all depends on your point of view." And I can guarantee you that those two people can sit there in those positions from now until the cows come home and they will never agree on the color of that ball until they get up and walk around the table and look at the situation from the other person's point of view. So I think that's the purpose today. We have the regulatory agencies here. We have the oil and gas operators here. We have the owners and designers of the FPSO systems here. We have the certification agencies here. So there's absolutely no reason why we can't all get out of our comfort zone and move around the table and look at things from the other person's point of view, and I think we'll accomplish a lot of what you've heard expressed here in the first two opening comments about what lies ahead of us in terms of the task. So the format we're going to use is this morning and right after lunch we'll have presentations by our distinguished guests from the regulatory agencies around the world. They will conclude their remarks around 1:30 this afternoon. Following that, we will have comments from the oil and gas companies, the operators of the FPSOs and the certification agencies. Following their presentations around 4:00 o'clock this afternoon, we'll have both groups come back to the head table and we will open the floor for Q and A at that time.

We're not going to have Q and A following each presentation out of the fear of taking someone's time away. So we'll let all the people speak and then we will have the Q and A. So as you hear the speakers today, please make notes of any comments or questions you'd like to ask. The direction given to the industry people following the regulatory agency's presentations are, number one, what are you doing as an operator or a contractor or a certification agent? And also, what are your comments relative to what you've heard the other regulatory agencies say this morning? So they will have an opportunity, the first shot at making comments about what the regulatory agencies say and then you will have your shot about 4:00 o'clock this afternoon. So please bear with us and we'll try to do our best to stay on schedule. Our first speaker is Jim Regg with the Minerals Management Service out of New Orleans. Jim?

MR. REGG: I, too, would like to welcome everybody here. Looking out over the crowd, I'm really encouraged. I remember we did this I guess back in 1996, April of '96, it was really our first workshop, and we had roughly a hundred people there. The crowd's grown a little bit. I'm sure the opinions are still the same. Maybe there's a few more here, so I'd be encouraged to hear some of those. I thank you very much for the introduction. I would also like to add to the statement Phil said. If we step out of our comfort zone and just take a look at these issues, if you have questions, let's ask them, let's get them on the table, because as we're building this, as you're going to see in my presentation, there's a lot of opportunity for input and it doesn't do us any good if we don't know what your issues are and what the concerns are. So it gives us an opportunity to explore it. I am going to talk about the MMS perspective. Hopefully, I'll lead in a little bit to help out with the Coast Guard presentation that will follow me. I do want to open up, though, with just maybe a -- my perspective, anyways, on why I don't think we're seeing enough FPSOs on the Gulf today. Certainly around the world they're becoming maybe a routine application of technology. I understand there's probably 70 in the current fleet. But when you start to look into them in a little more detail, you see the water depth applications, 85 percent of them have been in water depths less than 1,000 feet of water and they've also been historically installed in areas with minimal infrastructure. The Gulf of Mexico is a little bit different. Out to about 1,000 feet of water, we have an extensive network of infrastructure. The preference has been towards the fixed platforms and more recently in the deep water the things like spars and TLPs. There's also been a risk perception issue that we've had to deal with in the U.S. that's maybe been a hurdle for some in considering an FPSO. As we started to look at this in -- well, really, if you go back to even earlier discussions pre -- before our workshop in 1996, I have information in my files from meetings with operators and contractors about potential FPSO applications in the Gulf of Mexico back into the early 1990s, but really it's been more focused in the more recent years. When you look at, say, the last two to three years, we really felt a need to develop some type of decision model. What I picture here is a graphic that tries to pull out different aspects. We have a number of guidelines and standards, recommended practices. We've got policies, existing regulations. There's different review strategies that have been built. These have been applied typically to shelf type of projects. They have been extended into deep water by case-by-case reviews. There's also been other documents and experiences from systems around the world that we're at least aware of. The part of this decision model, though, that we looked at was to say how can we bring this thing towards a strategy toward implementing FPSOs in the Gulf of Mexico? We decided that maybe the best approach is an iterative approach where we engaged the Coast Guard and the MMS and industry in a lot of the decisions. We take all these documents, the existing regulations, documents, things that we knew, things that are ongoing and developing and try to review those. Ms. Kallaur mentioned earlier that the OOC has set up a team to do that. That's our iterative approach and that's the mechanism we're using. Parallel to that path is this idea of some programmatic environmental and technical studies. You heard the reference to a comparative risk study and the environmental impact statement. All these will feed into that decision. Going back to the environmental impact statement in maybe a little more detail, just to give you a sense of what we're investigating, we selected a lengthy configuration of a million barrel storage FPSO, processing capabilities up to 300,000 barrels of oil per day and 300 million cubic feet of gas. Based on the technology that we're seeing in the Gulf of Mexico in the application of subsea and the deeper water, most of the technology tends to be leaning towards clustered type of subsea development. So there may be multiple subsea clusters tied back to the FPSO. Then the transportation obviously by shuttle tanker with 500,000 barrel storage tankers and gas transport by pipeline. I wanted to mention the comparative risk study again. I think in addition to the EIS, this is another important component in our decision process. We are interested in the relative risk of FPSOs compared to the existing Gulf of Mexico deep water production facilities. If you look at it in terms of what's out there establishes -- is an acceptable level of risk, we haven't established risk acceptance criteria. We haven't put any numbers to these things, but these are approved, they're operating. So it establishes a risk emblem. What we want to do is take this FPSO and see, okay, how does it fit in with these others. Again, OTRC and DeepStar have been instrumental in the work. They brought in a company EQE to help us out in facilitating the meetings and the Coast Guard has been a major player. To update you, phase 1 was system definitions. We completed that work. We've also completed identification of the events and outcomes. We just recently embarked on what we call the consequence and frequency phase. This is more into the quantitative aspects of the study. Once we complete that, we'll take those results, we're going to go through a certain series of refinements and look at some potential mitigating alternatives. I don't think the intent there is to say we're going to impose these alternatives. We're going to explore them. We want to identify them, list them out, understand maybe from a qualitative perspective how these mitigations may impact your operation. And then again, project completion by January of 2001. The logical question might be, okay, you have all these things together and this is all done. Fine. Great. What do you do after the EIS is completed? We think that if an application is filed with MMS that fits within the boundaries that were investigated in the EIS, the logical step is the normal environmental assessment route based on that site- specific application. If it's outside the boundaries, we probably have to take another look at it. It may involve some type of supplemental work to the EIS. Maybe we can get away with something, but there's some uncertainties there. All during this, though, there will be engineering and safety reviews that are all sort of going through these same types of -- you know, looking at the system to make sure we have a safe system.I wanted to spend some time to talk about our current regulatory authority. Our existing reviews for anything offshore -- and I'll focus more on deep water, but once you get to the development phase is what we call our development operations coordination document. This is really where you identify your development intentions, what you're going to use, how you're going to do it, what your timing is. We use this to initiate our public input process. We also use this to do our environmental review. We also use this to trigger what we call a conservation review, looking at the development to make sure that this development -- that the resources are being developed properly. There's other existing plans, permits and applications, submittals that come to MMS that are too numerous really to list here. Pipeline applications, process, safety system reviews, those sorts of things. One of the key points, though, that's been developing in deep water and we think is going to be a cornerstone for FPSO applications is what we call our deep water applications plan. And at this point, I guess I just want to make a point to you that we believe that the existing -- the capability exists right now for us to review an application. If we stopped today on all these other initiatives, we could review an FPSO application. We could probably -- we could process it through our system. It wouldn't be neat. It would be complicated. It would require a lot of extensions of our regulatory program, operating departures, all the things that we've had to do with some other systems. So you can see that one of the real goals in focusing on some of these regulatory changes is really to tighten up this program. But again, I want to leave you with at least the sense that the capability does exist for us to review an FPSO-based development. A few slides here just to focus you in on the deep water operations plan and our strategy. We received this plan in three parts: A conceptual part, a preliminary and then it comes in as a final. There was a guideline that we worked on several years ago with industry. We've had the opportunity to refine it and it seems to work very well. It takes a total system perspective on the development. We're looking at from the sand face through completion all the way through the transportation, and we want to understand how one system affects the other, what implications they have, how these things are operated, understand the equipment. It gives us an opportunity to address things like alternative compliance where you look at things that maybe aren't established in the regulations or aren't clear in the regulations. It also gives us the opportunity to look at departures. I think the important key here was -- in developing the deep water operations plan was we wanted to avoid writing regulations that would have to be revised on a yearly basis or maybe every other year. The fast pace of deep water, the fast pace of a lot of the technological systems wouldn't lend itself well to developing a set of regulations that would have to be revised. So the idea was let's avoid the unnecessary regulatory rewrites, concentrate on a strategy that's flexible enough that allows us to meet our needs and your needs. The timing of these deep water operations plans, this is with a perspective on you, the operator, when you would -- when you reach certain milestones in your project development. You make a discovery. You've conceptually selected the system you're going to use. You decided you're going to develop this with an FPSO. You would submit to us the conceptual part of the deep water plan. We would take roughly 30 days to review that and we would approve that document. Then you'd move on through your process. You've got that approval in place and you're going to a preliminary engineering stage. Complete that work, identify what types of alternatives are -- alternative compliance measures, maybe alternative technologies, new technologies that aren't addressed in the regulations, you would identify those and submit those to MMS in this preliminary deep water operations plan. That's more of an engineering intensive document, so it takes a little bit longer to review. Then once you've initiated production, you've been on production, sustained production for 90 days, then you would submit to us the final part. That's really just to round these things up. So you can see it's a phased approach towards this review that tries to give you the incremental approvals before you have to make decisions about procurement and which direction to go. Just to concentrate a little bit on some of the planned enhancements that we've identified with the regulations. This is an ongoing effort. Again, it's this iterative approach. You remember my two-arrow slide earlier? It said iterative approach. As we move more to your left -- my left, your right, as you move that way you find that you get some more certainty. And that comes again from these discussions, these ongoing discussions we have. This is a part of that effort where we try to learn more. But to concentrate on the things that we've identified to this point: Subpart B, that's where we identify all our plan submittal requirements. We've decided to incorporate the deep water operations plan into that Subpart B as a plan. Up to this point, it's been addressed in what we call notice to lessees with a guideline. This will now be incorporated into Subpart B in the regulations. We want to address curtailment of operations and what decisions are being made. That will be integrated into the Subpart B. Hazards analysis, we think that's a critical point, specifically with the complexities to proceed in some of these deep water developments. And the conservation review. Again, we're interested in full development and we want to avoid premature abandonment.

What we call Subpart I is our platform or facility regulations. We address design, fabrication, installation, use, inspection and maintenance. Up to this point, that's been a very structured, rigid and lengthy document that includes a lot of prescriptive requirements and we intend two approaches here.

The first is to look at a technical modification. There's API documents out there now that do essentially the same thing, but have actually improved upon what we have in our older regulations. So we would be looking at adopting the API-recommended practices and doing away with the prescription. The second effort is a little more detailed, which will be a full rewrite of Subpart I, and that would be to address all types of production systems, not only the fixed platforms which we have in the regulations now, but extending them to floating production systems.

There are a number of industry standards that we've identified that we think are going to play an important role in our regulatory program. RP 2FPS was mentioned earlier. 2 RD, which was design of marine risers for floating production systems, is another one. 2 SK, 14 J, again to support the decisions that we're trying to incorporate in other parts of the regulations. There may be some others. Offloading guidelines have come in in some of our discussions, what types of experiences, what types of guidelines are out there available. Of course, this leads into some things that would be an interface with the Coast Guard. Offloading and the transportation by shuttle tanker is going to be Coast Guard responsibility. But again, looking at it from the total system perspective, you want to understand the different safety systems and what's there. Our interface with the U.S. Coast Guard is primarily established in the Memorandum of Understanding. That became effective in December of 1998. We're in the process of going through an implementation phase which includes identifying the different standards and regulations that each agency has and attaching that to -- basically overlaying that on our Memorandum of Understanding.

We also are looking into it in great detail to determine are there enhancements that need to be made specific to the tables of responsibilities that are established by this MOU? And our only goal is to have clear jurisdictions at the component level. We really want to be -- if I can say this, we almost want to be talking as one agency. We want to make it clear so when you have an issue, you know where it's going to go, you know who to approach with it. And this is an active dialogue. Again, another iterative approach. We have working committees with the Coast Guard to work on those issues. My closing slide is just, so what about FPSOs in the Gulf of Mexico? Well, no decision has been made. We are moving forward, but we want to make sure that we have the opportunity to evaluate our EIS and comparative risk study. We want to make sure our regulatory program is consistent and up to date. We want to make sure that we have clear jurisdictional boundaries with the Coast Guard. And ultimately, we really must be assured that an FPSO does not increase the general risk over other development systems. With that, I'll close. Thank you.

LIEUTENANT COMMANDER PROCTOR: Good morning and thank you. The Coast Guard thanks you for this opportunity to present to you this morning an overview of the Coast Guard perspective and Coast Guard regulations that affect FPSO operations, particularly in the Gulf of Mexico. My job this morning is to follow a little more in detail Captain Marsh's opening good news/ bad news remarks. So, in that respect, I'm a messenger, if you will, and that's why I'm standing behind the podium. I think I'd like to begin this morning by answering a couple of questions that come up repeatedly which Captain Marsh also touched on this morning.

Actually, before I get to that, I'd like to give you just an overview of some of the assumptions that we developed in preparing this presentation and that was that your interest is certainly the regulations as they apply to FPSO operations and that my focus primarily in this discussion will be on the Coast Guard requirements and that the issues and the discussion that I present this morning reflect the current policy that the Coast Guard has issued already.

The three questions of mutual interest, I guess you could say, the first question focuses around whether FPSOs are going to be considered vessels or facilities. And the Coast Guard's legal determination was made earlier that they are, in fact, vessels and that that review was determined by the definition of "vessels" as found in the U.S. Code. The second highly asked question that we answer these days is whether the produced oil that's stored on board the FPSOs is considered cargo. And the answer to that is yes, as well. And as such, the tank vessel requirements not only for the manning, but also the OPA 90 requirements for tank vessel pollution prevention requirements would apply in that respect. And then the third most often asked question, keeping in mind the other two, is whether FPSOs need to meet the OPA 90 double hull standards. And as Captain Marsh mentioned earlier this morning, yes, in fact, that would be the case. Just as we applied the OPA 90 double hull requirements to standard tank vessels operating in the U.S., so would we apply this to FPSOs. And I've referred to the OPA 90 double hull phase-out scheduling as well. With all of that in mind, what I'll do is I'll go into the overview of the Coast Guard requirements. And I assure you I won't fully break down all of the Coast Guard regulations because as cool as it is in here, I'm afraid that if I did, I'd start to see a few heads starting to touch the top of the tabletops here. So I'll keep it a very high level and broad overview, just give you an idea of where we are. Although, as it's been mentioned a number of times this morning, there are no FPSOs operating in the Gulf of Mexico at this time, if a company came forth and made a presentation to us, these are the existing regulations that we would apply to FPSOs. The Coast Guard first -- they first addressed this issue very generally back in 1992 in a Coast Guard policy letter, and since then, there has been ongoing enhancement, revisions to the policy, how we would apply these regulations to FPSOs, both U.S. and foreign flag operations.

For U.S. flag vessels, as with any other U.S. flag vessel, they would have to undergo a plan review, extensive plan review on the safety side and would also be required to be inspected by the Coast Guard on a regular basis and maintain its certificate of inspection. And, of course, in order to obtain that, the vessel must comply with a whole host of Coast Guard regulations as you see presented here, not only with tank vessels and the engineering requirements, but also some of the lifesaving compliance requirements and other regulations that apply to mode of operations, as well as Subchapter N, the Outer Continental Shelf activities, and a number of other pertinent regulations that apply to the vessel design, its operation and its structure. I, too, personally share a number of Captain Marsh's concerns with the foreign flag FPSOs, but we also have developed a policy that applies to foreign flag vessels. Similar to a U.S. flag vessel maintaining a certificate of inspection, a foreign flag vessel would have to maintain the letter of compliance issued by the Coast Guard, which is also issued as a result of Coast Guard inspection. And in order to obtain the letter of compliance, the vessel is expected to comply with the applicable international treaty, such as SOLAS and MARPOL. If that vessel is unable or unwilling to comply with those international treaties, then we would apply the U.S. regulations in full and inspect it as a U.S. flag vessel to all of the requirements that I presented earlier. As such, a certificate of inspection would be issued to that vessel. Applicable to both the U.S. and the foreign flag vessels, they need to maintain an approved pollution response plan, which is, of course, approved at the Coast Guard headquarters level in the office of response.

In addition to the Coast Guard requirements, the ISM Code and the STCW requirements would apply as well to these vessels. For U.S. flag vessels, the -- well, for U.S. flag vessels operating overseas in foreign OCS areas, both the ISM and the STCW would apply. However, U.S. flag vessels operating here in the Gulf of Mexico are engaged in domestic voyages, so these international requirements would not necessarily apply. However, the Coast Guard does encourage the voluntary compliance with either the ISM Code or the MMS SEMP program. There's been some discussion already this morning about the future of FPSO Coast Guard regulations.

Particularly these are highlighted in the notice of proposed rule making for CFR 33, Subchapter N, which was published last December. And what this does in large part is it gives a central focus to this advancing technology, this particular segment of this new marine environment. It does address the floating OCS facility, the ISO design and equipment requirements, and it will incorporate the API RP 2FPS standard which is expected to be published in the very near term. We do highly encourage all of you to review and comment on this rule making. Currently the comment period has been extended until early July, but there is a -- there is a possibility and I would say it's safe to say at this point a high probability that that comment period will be extended a few more months as well. Within Subchapter N of the regulation revisions, the U.S. floating facilities, again this slide shows that it's a central spot that highlights all of the requirements for the U.S. facilities, referring again to the API standard and the applicable engineering requirements and operating and design requirements, as well as for the facilities in particular applicable to this morning's discussion, the floating facilities that store oil in bulk, the requirement to again comply with the tank vessel and the OPA 90 double hull requirements. For FPSOs that undergo U.S. flag tanker conversion, certainly the plan approval is required, and these -- the tanker conversions must comply with various regulations here as highlighted in 33 CFR. Mr. Jim Magill in our headquarters office will be going into further detail on tank vessel conversions during tomorrow afternoon's workshop session and, incidentally, he is also our project officer on the Subchapter N regulation revision. So I would also encourage you to talk with him, if you have that opportunity, about this project. The Subchapter N project also addresses the foreign flag operations and the design and operation requirements that they are required to comply with, whether it be meeting the U.S. floating facility requirements under 33 CFR, whether they meet a design and equipment requirement of the flag state that is found equivalent to the U.S. and that determination would be made by the Commandant, or certainly that they demonstrate and have on board the appropriate SOLAS and safety equipment certificates. Again, as with the U.S. vessels requiring to meet the tank vessel requirements for storing oil involved, so too will the foreign vessels. I want to touch briefly upon other foreign issues, particularly the citizenship employment requirements aboard these vessels. For any operation that's contemplating using foreign citizens aboard the vessels, there is a process which they are required to submit a request for a waiver to Coast Guard headquarters, which at that point we would work with the Department of Labor to determine whether a waiver should be granted and under what conditions. To talk a little bit this morning about lightering activities and certainly FPSOs would be engaged in lightering and, as such, the existing regulations found in 33 CFR 156 do apply, as well as the tankerman/persons in charge requirements and the work-rest provisions. There had been questions posed to our office regarding the establishment of designation of lightering zones and those provisions are already in place by the regulations which is designated by the district commander. Certainly for the Gulf of Mexico that would be the Coast Guard --At the bottom of the slide we also have a -- one point to also consider and that is the shuttle tankers or barges that are transporting the produced oil back ashore or to the distribution point would have to be U.S. flagged regardless of whether the FPSO is U.S. or foreign flagged.

Again, I want to reiterate just some of the comments that have already been made this morning about close working relations that have been developed between the Coast Guard and the MMS on this whole issue, the Coast Guard's participation and MMS's environmental impact statement and the NOSAC, National Offshore Safety Advisory Committee's subcommittee review of any added risk of deep water activities, as well as our participation in MMS's study on the comparative risks of FPSOs, and certainly our continued work and close coordination of both agencies to define the FPSO regulatory environment. On that note in particular, I want to take a brief opportunity to commend Captain Marsh's office and his staff for working closely with the MMS's regional office on the continued MOU implementation. This is a very brief overview of the Coast Guard's regulations as we would apply them to FPSOs today. It's not to say that we're so inflexible and rigid that we're not willing to consider other viewpoints. Indeed, that's why we're here during this workshop, to share all of your experiences and to listen to any other proposed alternatives. But again, as Captain Marsh had mentioned earlier this morning, although the marine safety program is very interested and very proactive in working with risk-based alternatives, our regulatory scheme is such that it's not going to be something that we would implement overnight, but we do have interest in working with the other regulatory agencies and industry to develop a sound approach to these operations. Again, I thank you for this opportunity this morning and I welcome the opportunity to meet with many of you individually during the next couple of days, and I look forward to a very productive workshop. Thank you.

MR. FINNIGAN: Can you all hear me in the back? Thank you very much. Okay. Thank you, Mr. Chairman. As Phil said, I'm Paul Finnigan. I'm with the Western Australian Department of Mines and Energy, and my e-mail address is just there. I'd like to thank the sponsors of this event, MMS and the Coast Guard, for allowing us to present here today and I hope sharing our experiences to you will be of mutual benefits and we'll have a good workshop.

Okay. My presentation is nominally called "FPSOs - Australian Experiences," which should actually be really Australian and U.K. experiences because anyone that has an accent realizes I'm not Australian, I'm a Brit. I've only been in Australia for 18 months, so my experience is also related to six years while I worked in the U.K. And Peter Mills is here as well. I don't want to steal his thunder.

I was heavily involved in inspections of FPSOs in the North Sea, including two very novel FPSOs, one which is now down in Brazil, and also I was the assessment manager for a novel FPSOs in the North Sea. Both of those FPSOs are unique. They're the only types of those vessels in the world. Before I was with them I was with -- (inaudible.)So I'll get on it so I can get through it in the next 19 minutes. Okay. We've seen the workshop focus. It's in your fliers. I'll dwell on that. I'm trying to touch on all those topics this morning. A quick FPSO overview. I have some slightly more updated figures. This is 1998 figures from Bluewater. Some 47 FPSOs in use worldwide, 24 under construction. We have seven in Australia at the moment. There's about 20, 23 in the U.K. and Norway. A few of them are by oil companies, COSSACK PIONEER, GRIFFIN VENTURE in Australia. Other main players who have leased FPSOs to other companies are PGS and Bluewater and (inaudible.)I thought I'd put this slide up quickly because it's a nice graphic. All the graphics today are in the public domain, they're on the web, so my acknowledgment to those companies for providing those. This is a good overview of a FPSO. You start at the bow. There's been some issues with waves breaking over the bow and wetting the equipment, and also slump across the hull and causing deformation of hull plate at the bow. There's a small breakwater there to perhaps mitigate against green water or inundation of waves on deck. Not shown, obviously, is the mooring system. There are various configurations of that. There's a lot to be said for pushing into deeper water. Obviously, there's chains and wires and also synthetic fibers as well along the mooring chains. Obviously not shown also is maybe traditional marine (inaudible) up into the turret area. There are alternatives which are external turrets over the bow or sometimes over the stern as well. This has obviously been new built. It's an internal turret. This vessel has the swivel and then the process plant on there as well.The process is normally organized. The most hazardous is the furthest away from the accommodations, which is this ways aft. So gradually moving back through separation, as well as utilities, power generation, etcetera. On this one, the accommodation where the personnel will muster, and emergency is here. There's a fire and bus wall in front to protect the refuge from any incidents. This behind there is well protected. Obviously, the offloading and obviously the hull and the storage tanks. So it's quite --Australia FPSOs, we have seven. We can run through these. The GRIFFIN VENTURE operation man is sitting in the front row, so if I get it wrong, he'll tell me. (Naming ships listed in slide.)Just to quickly jot through some of the advantages of the FPSO. Large deck area, potential topsides weight. Perhaps inherently safe or the prospect of inherent safety design because you can sometimes achieve separation by distance of the process from the accommodations, although there is a caveat to that I'll mention in a moment. Deep water capability which we have mentioned, moorings, etcetera. The economics of leasing. This may be advantageous to the oil companies' balance sheets if we lease an FPSO for an operator. And obviously also, they're reusable. Once the field life is exhausted, the moorings can be disconnected, tow it away and perhaps use it elsewhere. In Australia, we have a mix of permanent and disconnectible FPSOs, primarily dependent upon the environmental conditions at the location. The GRIFFIN VENTURE and the COSSACK PIONEER both have disconnectible turrets to allow the FPSOs to move to shelter in case of impeding cyclones. On the northwest shelf of Australia, we have cyclone season till April. So sometimes if they're on the path, we have to disconnect and move them away. Further east in the Timor Sea, the cyclones are unsure, so the FPSOs are not (inaudible) --This is the GRIFFIN VENTURE. This is the riser turret mooring here which is disconnected and dropped back into the sea if the vessel has to disconnect and move off station. It also has its own motor power and thrusters to move away to safety. Similarly, the COSSACK PIONEER, this part is the riser turret and it drops away to the sea and the vessel motors away to safety. This slide shows (inaudible) --Okay. So the environmental conditions on the northwest shelf, just for your information, 100 year design storm (Hmax) approximately 20 meters, 60 feet, 10 to 15 second period, current 2 meters. The comparison to the only other place I know in the U.K., certainly not North Sea, west of Shetlands, this is a more severe area and they have Hmax of approximately 32 meters, 96 feet. So big waves in both areas. And the water depths in COSSACK PIONEER are 240 feet and 390 feet at GRIFFIN. In the Timor Sea, the cyclones are more developed there and have more strength. The this one has 1140 feet. The BUFFALO shares the distinction of being the deepest and shallowest (inaudible) -- New build versus conversion, some of the issues. A new build is typically outfitted with hydraulically-driven deep well pumps in cargo tanks. That sometimes also brings on issues if the deep well pumps are broke, you draw water (inaudible) -- however, conversion almost always retains traditional tanker (inaudible) which is a recognized hazard. Additionally, its hazard is major in front and below where the guys muster in case of an emergency. Also, although you're achieving perhaps separation by distance of the main process, there is an issue here with the pump group. And obviously one of the drivers or one of the key inputs to the risk analysis of that is how often, how frequent and what the duration is of the use of the pump rooms. Also conversions may not be double hull on the bottom. This may impact on ship collision scenarios.

Okay. Some further issues on new builds and conversions. New builds perhaps allow better integration of the design process with the goal setting philosophy of safety case style legislation which has been adopted in Australia and the U.K. You consent to start with a clean sheet and then -- and then within the constraints given to you perhaps arrive at a good vessel. There are issues, obviously, with an old tanker, converted tanker. The age of the vessel for conversion also may be a problem. You've got to do some very good structural surveys to make sure you've got the right vessel. The quality of the hull and the tanks and the tank coating may be an issue. You've also got to consider that because of the field life of the FPSOs to be converted, it may be on station for a long time past the traditional dry docking period for a tanker. Okay. Just some data about the WOODSIDE NORTHERN ENDEAVOR which is in Australia, the largest FPSO in the world. 170,000 pounds production, 1.4 million barrels storage, 220,000 dead weight tons and 380 meters, 1140 feet water depth. It's a new build with internal turret and I think the biggest roller bearing in the world, 23 feet in diameter. Nine-point mooring system. It's got 21 risers. That's a very gray picture of the vessel in the shipyard. It's about a 16,200 process on deck. That's just another picture of it. Okay. Next topic, oil storage and offloading. One of the perhaps big issues is whether an oil company will use its own pool or whether (inaudible) -- if that's the case, obviously things like spot management issues, origin of the vessel. If you know it's your own oil company's tank, you tend to have an idea of its quality. If you're using spot charter, you don't have a good handle on the quality of the vessel. And BHP, who use some of those types of vessels, they do (inaudible) --Other issues, use of the wing tanks to store oil instead of ballast. Again, this may have implications for ship collision scenarios. Tank overpressure indication or vacuum issues. There was one in the U.K. where they had a deform of the tank top or ruptured it because the PV breakers on the tanks were isolated, I think. This comes back perhaps to competency of personnel. Also, obviously on an FPSO you have large inventory, bulk oil storage, in tanks close to process equipment. Fire and explosion incidents on the main deck and severe consequences. If you have a missile generation scenario, throws a few blades or disintegrates, it may not be so much of a problem in relation to the cargo. Also, obviously cargo tank entry is always a recognized hazard on tankers. This is a problem if you have to pull -- enter the tank for any reason. Other issues, there's various offloading systems available now. Submerged turret loading. Other issues, dynamic positions for the shuttle tankers or non-DP shuttle tankers. They may or may not be allowed to get away with it depending on the environment conditions you want to load or continue to load or disconnect. Separation distances between the FPSO and the tanker may be an issue. In the North Sea, we are doing 40 to 50 meters from the bow of the shore tanker to the stern of the FPSO, so it doesn't leave a lot of margin for errors. And as I mentioned a moment ago, environmental states for the offtakes. If you have DP, you may be able to stretch together a little bit more. This is in terms of allowing the tankers in the field and connecting with hoses and various mooring lines, etcetera, emergency disconnection, and applying disconnection comes into play here. I thought this slide again will -- this is on the U.K. PIERCE. I put this on just to illustrate this vessel has a combination forward turret. So like the SCHIEHALLION, if there's a smoke or a fire gas explosion, the smoke and gas will tend to drift upward rather than drift upward into the accommodation. This one has a stern uptake here and the turret connection is under water. I'll show on the next slide. Very grainy slide. My apologies. This is the STR system. This is in the hull of the tanker and the -- (inaudible.)

This is a better picture of it. The tank hull up here -- (inaudible.)Oil storage and offloading issues. You can have a phenomenon called fishtailing in non-co- linear seas. That's when the waves and wind and sea aren't aligned. The shore tank may be aligned this way and if the FPSO is not perfectly aligned with it, sometimes this can offer operational restraints and you may consider thrusters to allow yourself to line up better. Also, if you do have fishtailing in non-co-linear seas, it may be due to excessive motions on one or both of the vessels. Other issues, cargo hose connections to the shuttle tanker. Some tankers are connected via the traditional midships manifold, and the forward bowhouse is always manned when we're doing uptakes. One particular vessel of mine had a forward house and they run the offtake from the bridge which is 200 odd meters back from the bow and they didn't realize that the bow was moving forward towards the FPSO and they actually had a collision. So I think forward bowhouse is a good idea if you're using that type of system. If you've got a long separation distance between the FPSO and the storage tanker, it may not be so much of a problem. Emergency shutdown systems. This may have an impact if you're using not your own tankers, if you were just discharging people, you may not be able to fit the telemetry system. Again, in the North Sea we had dedicated telemetry systems between the FPSO and the shuttle tanker so either one could shut down. There was no problem. Cargo hose rupture, environmental issues. Consider the use of weak link, dry couplings. Manning and evacuation issues. There was perhaps some issues with the extent of the competency on board FPSOs. There was a tendency perhaps in the early days to throw a bucket of water on (inaudible) and declare it (inaudible). They were not mariners. That didn't work out in some instances and the company had to look at getting some marine expertise on board. As has been mentioned by the Coast Guard, I think, earlier, there is perhaps an issue with whether (inaudible) -- certainly in some countries the FPSO may be registered as a ship or it may be registered solely as a petroleum facility or both. Those are issues, flag state requirements, maritime union issues, SOLAS. With FPSOs in deep water, it may be remote from hospitals, etcetera. This may have implications with medivacs. If you've got a guy injured, got to get him back to shore to a hospital, certainly the BUFFALO VENTURE is about three hours flight time. This (inaudible) -- also, of course, in bad weather, the choppers can't get in. Another issue, TEMPSC, free-fall or davit launched. Having it on the free fall, my personal feeling is it's the only way to go in an emergency. Far better than davits on lifeboats and rather than a chopper, I'd rather go free-fall. You tend to see these particularly in the Norwegian sector and on a new build you may see it has more constraints than on a conversion. It's not possible, but it can be done. Vessel motion and stability. The motion envelope of the vessel may have implications for process design. For example, level control in separators. You may have to (inaudible) --Orientation of the process vessels along the axis with the least motions. That's normally fore/ aft access for the separators. Vessel motions may limit certain operations, for example, maintenance. If you're slinging your equipment around, you can't do that if the vessel is rolling excessively. Crane operations is another one. As we mentioned previously, helicopters. If the vessel -- if it's (inaudible) --Okay. I've got a few minutes. Very quickly, human response to vessel motions, seasickness and also --Stresses and bending moments upon the hull, (inaudible) hogging and sagging conditions you want to avoid, obviously.

The difference between a trading tanker and FPSO. Deck loads, topsides weight limitations and effects on gravity. (Inaudible.) Gas handling. Particularly in Australia, I've been told on one FPSO we had excessive heat radiation from a flare which led to no-go areas on the deck space. Okay. Perhaps gasoline injection swivels, the integrity of the seals. High pressure, there may be issues there. The last one there is LNG FPSOs. I think Mobil has those gas to liquid systems. We had an FPSO incident in Australia, we had a gas turbine rotor fail on one vessel led to a large scale fire. No fatalities, but the vessel was off station for four months. Shuttle tanker near misses. We had a tsunami wave generated by an earthquake off Indonesia which caused the offloading tanker to move very rapidly towards the FPSO. I think it missed the FPSO, but there was some damage to fair leads, etcetera. Another incident the tanker lost power and (inaudible) --Some other issues which are included in the (inaudible) of volatile organic pound gas systems, environmental issues. Green water on decks we've already touched on. Integrity of seals we've touched on. This is a quick one. Green water inundation of a deck. You can see the waves coming over the side and there's the process awash. TEXACO CAPTAIN, this is the big thing in the center here. They have flexible hoses that -- (inaudible.)One final issue I'd just like to touch on, in the U.K. (inaudible) obviously 350 yard gas pipeline, if the line severs, you tend to have an explosion. I think I'll leave it there. Thank you very much, ladies and gentlemen.

MR. PIKE: Rest easy. I'm going to be very brief. I don't have any formal presentation or slides for you. When Charles approached me this morning, I wasn't quite sure whether I'd be better off back in my office responding to inquiries why drillers drop drill pipe and how they do that. I hope this will be an easier job and the audience will be a little bit friendlier. I'm the manager of Operations and Chief Safety Officer of the Canadian Newfoundland Offshore Petroleum Board. We're the regulatory authority for the Newfoundland offshore area within Canada. There are actually three boards operating within Canada regulating offshore activities. There's our assistant board in Nova Scotia which regulates activities in the Nova Scotia offshore area and the National Energy Board which handles activities in the north.

With regard to FPSOs in Canada, we haven't treated them any differently than any other petroleum development. They go through the same regulatory process and review. We currently have one project under development. The hull arrived from Korea last month and as of yesterday, I understand it, they did the last heavy lift. The clear stack was installed yesterday, I hope, or I left lunchtime and I understood it was being installed. So we're still in the middle of that project and to speak too much about operations would be a bit presumptuous at this stage. The operator in this case has decided to flag this particular FPSO, so it does carry flag state rules. So we worked very closely with Transport Canada, Marine Safety in Canada. They're the regulatory people on the marine side. They kind of split from the Canadian Coast Guard who handle the oil spill side, just to complicate matters. It's the first time out, so there have been some glitches. I think it's worked relatively well and I guess there's nobody here from Terra Nova to challenge me on that one. But it has been a challenge. There are very different cultures involved in those two aspects and we have been able, I think, to work through a solution and hopefully as we go forward we have come up with easier ways of doing it. That's pretty much what I had to say. .

MS. MATTOS: Good morning, ladies and gentlemen. It's an honor for me to be here representing Petrobras to tell you some aspects of FPSO use in Brazil.

First, I would like to show you how this presentation is planned. As an introduction, we will see some figures about FPSOs in operation, installation, conversion and contract phase. Then I will present a very brief overview of our ruling scenario (inaudible). Regarding design, only aspects related to human safety and environmental protection will be mentioned. Only two facets of conversion will be presented. The comparison of as new and all new philosophy and the steel replacement in ships (inaudible) offered by contractors. The vessel motion in the offloading operation are the subjects that we will present as operational experience. Technological needs, I've made the selection of some projects in development and/or those in which some improvement are still necessary, but always focusing FPSOs. To end the presentation, I will tell you how Petrobras is facing environmental management and operation also. This table shows some data on FPSOs and

FSOs operating at Campos Basin. All those in the use of this concept started in 1979. The decision of its intensive use as permanent system began in 1994. P-34 started production in 1997, followed by August. I would like to highlight the installation in water depth up to 6,000 are not considered in this table. There are some pictures of our first installed FPSOs. P-31 and P-32 and P-34 was a 55,000 dead weight tanker. All FPSOs shown here were from Petrobras fleet. As an example of some characteristics of FPSOs in Campos Basin, we have a turret system adopted in P-31. The mooring system is composed of eight symmetrical lines in free catenary. It has two bearings. The main bearings are three row roller type and it has several swivel path. (Inaudible).These three units were all FPSOs. P-33 and P-35 are operating, and P-47 has just begun to receive oil from P-36, a submersible platform. These two FPSOs are used as pilot systems for two fields. FPSO 2 has a cowl mooring system and is the only deep FPSO in operation. Five more units will be added to our list. P-37 are already installed. P-38 is finishing conversion, and P-43 and 48 are in contract phase. In this table, I would highlight the process capacity of up to 150,000 barrels of oil per day. P-37 is the third FPSO. ESPADARTE is first -- in 19 (inaudible). Until 1995, Petrobras was the only company allowed to run the oil business in Brazil. After November 1995, a constitutional amendment allowed the presence of other companies. The new petroleum agency was created in August of 1997, with the purpose of regulating, contracting and controlling economical activities linked to the petroleum industry. ANP is now in the process to (inaudible) -- in the case of offshore installations, the environmental license is issued by IBAMA. For the issuing of operational license for FPSOs, IBAMA has been demanding environmental impact studies and some studies related to risk assessment techniques in order to identify and evaluate the consequences of accidental scenarios. The maritime authority represented by DCP follows the IMO requirements. Recognized classification societies are allowed to perform audits, inspections and surveys to issue certificates related to conventions and regulations in the name of the Brazilian government. Guides and rules by classification societies are normally directed to new building hubs. Environmental is issued by Petrobras to be followed by during engineering design. Regarding human installation safety and environmental protection, some subjects can be highlighted. The first one refers to the boundary conditions that are in all safety environmentals. For example, maximum 20 parts per million oil contained in discharge water, computer simulation used for determining gas dispersion in open areas, and the various steps present in the fire accident allows the installation safety and the number (inaudible) and of gas protectors and passive protection. (Inaudible) we have the cargo tanks in preventive actions have to be defined into a (inaudible) in cargo tanks. Petrobras is one of the participants in the JIP that is a study of risk and reliability of -- relation to the scenario is defined for risk of condition.

We can make some comments considering the Campos Basin in reality. This map shows that the area in the Campos Basin where the platforms are installed is restricted to navigation. This means that as our facilities are not in commercial routes, we don't expect to have collision with passing vessels. The offloading operation happens according to the boundary conditions shown here. I would like to emphasize the distance between the two vessels, 150 meters, the offloading frequency, once a week, the quick release connectors and the strong maintenance routine. Condition going to supply boats is the most concerning scenario of risk collision in Campos Basin. Are determination of supply boats (inaudible) and with increased and the use of fenders on FPSOs. Regarding metocean conditions, we can say they are mild, not hurricanes and not so high waves. Our experience in conversion comprehends shipyards in several countries, China, Korea, Singapore, Spain and Brazil. For the first FPSOs, an as-new philosophy was adopted, meaning that all equipment and piping should be inspected and overhauled, if possible. This practice proved to be not economical mainly because some equipment had more than 20 years and spare parts were very difficult to get. Therefore, after P-35, the philosophy adopted was the all-new, meaning that all equipment should be replaced and only the hull would be kept. Regarding the plate removal, a comparison between the steel and those provided by contractors proves that the last ones were in worst condition. Sometimes when there is a cross- condition of the current and wind in relation to the long period waves, we can have a high roll motion response. If this phenomenon is associated with cargo loading condition where some tanks are partially filled with oil, it is possible to have a resonant motion. To mitigate this problem with FPSOs that were already in operation, a limit could be established for cargo load/offloading plan. For FPSOs that were in commercial phase, an enlargement and extension of the (inaudible) keel could be considered. The oil export in Campos Basin, (inaudible) until now, after until April of this year, we are confident on the reliability of this operation. Here we can see some pictures with details of the retrieval system used for offloading hose and hawser. (Inaudible) 3,000 is a new step of a problem that has begun in 1996. The problem is to develop technology to -- (inaudible) ultra deep waters at Campos Basin. To make visible a very comprehensive -- (inaudible) including governmental agencies, the Brazilian international technology community. Now I'm going to present some projects that are in development phase or that still need some improvement, but always related to FPSOs. I will start with mooring and then present riser systems. Taut-leg experience started in October of 1997 with a semi-submersible platform. Since October 1999, we have also an FPSO with a taut-leg mooring system at a water depth of around 1200 meters. It must be said that this FPSO has a cowl mooring system which is not (inaudible) by the -- the use of this concept in FPSOs with turret systems requires a more combined configuration. By now we have seven semis, five FPSOs or FSOs, and two buoys in Campos Basin that are used for -- polyester ropes, but some improvement are possible with modeling tools, protection against ingress of soil.

Several types of fixed points that can hold vertical loads have been used in our mooring systems. Nevertheless, improvement can be made mainly in the installation process. The challenge now regarding fixed point for mooring systems is the use of an inhouse development called torpedo pile that provides reduction in and coring and installation costs. This has been used for pipeline anchoring and it is now in tests for certification for mooring line specification. The DICAS mooring is a reality in small vessels. This concept has been exhaustively tested in model tanks and will be applied in -- (inaudible.)Regarding riser systems, some steps are still necessary to make feasible the use of steel catenary riser on an FPSO. In these sort of development we have decided to consider. In the option of two units close together, some transfer lines have to be utilized and consequently the -- here we have some critical issues, like fatigue life at both end connections and so on. Another concept that we are interested in is the tether buoy riser. Developments are running fast and we are expecting to have it ready for economical and feasibility study this year.Campos Basin E and P has been recommended for certification by BVQI in relation to the safety, environmental and health management system.

Also, the basic design of Petrobras has a specific demand for ISO 9001. But the company is not only interested in fulfilling legal and ruling requirements. It has just launched a program of excellence in environmental management and operating safety with the purpose of ensuring the operational safety of Petrobras installation, minimizing the environmental hazards and contributing to sustainable development. That's all. Thank you very much.

MR. OVENS: Good morning, ladies and gentlemen.

I want to just make some comments, probably expanding a little bit on what I discussed yesterday from a regulator's point of view, issues regarding evacuation and manning.

We operate one FPSO offshore New Zealand. In our case, we probably have one of the lowest crewing levels on FPSOs and we also have a rather special evacuation model. The manning levels are low primarily because the FPSO is permanently moored. In areas where a FPSO is vulnerable to typhoons or hurricanes and must be disconnectible then additional marine crew will be required once the vessel disconnects and makes for safety.

As I said yesterday, we used to have dedicated standby vessels. It was a requirement in our regulations to provide standby vessels to attend to offshore installations, but now we've gone away from prescriptive regulations to goal setting regulations. An important part of the legislation is the requirement for a Safety Case. The objective of the Safety Case is to ensure that all potential major hazards have been identified, assessed, controlled and recovery measures are in place, and that risk to personnel has been assessed and has been minimised to a level that is as low as reasonably possible (ALARP). We now require operators to do a QRA and assess the risks.

What came out of the QRA for standby vessels is that if you have storm conditions offshore, the crew on the standby vessel are at far greater risk than the crew on platforms or a FPSO would be. They tend to be tossed around in the sea and we found there have been some injuries reported by the marine crew on the standby vessels in rough seas. In these conditions there's no way they're going to render any assistance to the vessel or installation anyway. The personnel on the larger vessel or the installations are at less risk.

So initially we used to send the standby vessel to port, to shelter, and in the end we decided, well, we'll just take an approach that the vessel will be in the area, say, 50 percent of the time anyway, and when they are not in the field they can steam out from port when required.

The FPSO Whakaaropai is a conversion. One of the problems with a conversion normally is that you end up with davit launched lifeboats. The platforms now have free-fall lifeboats. The advantages are that with a free-fall lifeboat, you just pull the pin and you're gone from the vessel. The free-fall lifeboats actually go underwater like a submarine for a few meters and are driven away to safety. The advantage on a FPSO is obvious if it's listing to one side, with davit launched craft you've lost one half of your lifeboat capacity straight away. Also with a weather vaning FPSO, you've got the potential for smoke impairment.

Our lifeboats are located just below the bridge on both sides of the vessel in this area here on the slide. We also have emergency areas inside the turret. To actually get forward of the bridge you've got to have permission from the control room operators so they know there are personnel up in the front of the vessel. If there's an emergency situation, these personnel have got two choices. They can either get back to the stern of the vessel by trying to get back along through the radiation shielding or if it's a major fire, they're better off to stay in the turret. There is a TR room in turret where they can actually take shelter, or if they are up on the turret, there's an area in the swivel where they can shelter as well.

In case of a fire, they're probably safe because of the weather vaning capabilities of the FPSO. One of my concerns is that because of weather vaning, you can get smoke impairment of your lifeboat evacuation areas. After the GRIFFIN VENTURE fire in Australia, there was a review to look at the temporary refuge and to ensure that not only the temporary refuge was protected from smoke impairment but the area leading to the lifeboats at the lifeboat stations was protected as well.

The issue of the fast rescue craft again was an issue. Initially we had one stored on the vessel. It got to the stage where we just couldn't launch and retrieve it safely due to the sea conditions. It was decided again that if the crew can't train to use it and its use is only maybe 25 percent of the time in the field, then it's probably not worth having it on the vessel anyway.

I think also in the mind of the operator was the idea of doing live training drills. We had the unfortunate situation probably five years ago of losing two personnel who were killed in an accident offshore training on a helicopter winching exercise. They were being winched off the back of a work boat on a training exercise on a Sunday. They were actually on the end of the hook. Just as they approached the helicopter, the line parted and they fell back onto the deck and were killed. I have some problems however if live training is not undertaken - we need to find a balance between what is applicable for live training and what is obviously too much and puts the personnel at risk.

Means of escape. Again, I mentioned yesterday we have either helicopter or lifeboats. With the smaller size crews, we're getting close to the helicopter capability for one flight, but what we can do, we can transfer personnel to nearby installations. The prefered means of escape would probably be by helicopter and they would be shuttled off to Maui A or B platforms in an emergency.

If the helicopter wasn't able to fly for some reason, such as storm conditions, for instance, then they would use the lifeboats and they'll actually motor to the coast or to a safe location maybe upwind of the incident.

In our regulations we require the operator to file an emergency evacuation plan to make sure that the plan is achievable and the support is available for that plan. In our safety case, we also require a study to be done that looks at how will personnel be protected, how will personnel escape, and how will personnel be rescued.

What I found in most cases is quite often the goals that they set out to achieve in the model may be unachievable. We have to look at the methodology and the assumptions that they have made as well. The assumptions can be based on something that again is not achievable.

Often the safety cases are actually written by consultants who may not be fully familiar with the facility itself and we get comments like use the FRC, if available, which to me is inappropriate as we as regulators want to know exactly what's out there, if it's available or it's not. You can't reference safety equipment if it's not available.

I'll just mention here too that the essential part of the escape is the provision of smoke hoods, fireproof gloves, some sort of light source and a survival suit for every person on the facility. Our water temperatures are probably around 10 to 15 degrees. Hypothermia is a major problem with people going into the water.

We obviously encourage anyone in an evacuation to go through the various escape options. We have a hierarchy of evacuation. Helicopter first. Second would be lifeboat. Third, liferaft. And the last thing you want to do is jump into the water. So in all our drills we try to encourage people to get to the lifeboats. Getting into the water is going to be a problem not only recovering them, but also for survival. There are no dedicated firefighting crews on board as the primary function in the event of an emergency is to ESD and evacuate the facility.

I have included this slide showing the free-fall lifeboat here on our Maui B facility. Again, it is an ideal way of actually getting away from the facility rapidly.

I'd encourage anyone looking at a new build to incorporate this type of technology for lifeboats. They can be quite reasonably easily deployed and recovered. Again, in our situation, we launch them about once a year in drills, but they have to pick a day where it's going to be calm, maybe a day like this, it's pretty unusual, where they can actually quite comfortably launch it and retrieve it.

I just want to point out on this slide the radiation shielding here. It's an important feature to make sure that any personnel who are working forward of the process area, or in the process area, have some shielding from heat radiation in the event of a process fire if they have to escape from the area.

I want to discuss the manning issue in some more detail. It was a very controversial issue. We argued for a period of time, particularly with the maritime unions, and obviously we shared some of their concerns, but the main criteria was the definition of whether the FPSO was a ship or an installation, and also whether it was going to be disconnectible or permanently fixed. After it was decided it was going to be permanently fixed to the sea floor, the concern then was, well, what's the chance of a breakaway? Under the QRA the operator showed that the chance of a breakaway was pretty remote. And if it did break away, we're 50 Km from the coast, there will be ample time to properly evacuate. There are pneumatically fired mooring lines that could be deployed from the work boat to hopefully get some sort of control of the vessel if in the remote chance it did break loose.

With the crew levels, we've got 13 crew with 12-hour shifts. With the FPSO, the assumption was that it was no longer a ship, but with a lot of process equipment on board we needed to have people with process skills, and we got those internally from our platform staff. The manning initially comprised of 18 personnel but reduced with operational experience and reducing production rates. One of the challenges for the operator is that the high initial production rates and subsequent frequent offtakes occur at the start of the project when the crew have the least experience, and the vessel has only just been commissioned. The advantage of the reduced crew levels on board is that they contribute to a lower level of risk as well as lower operating costs for the operator.

The structure of the crew was supported by the Australian Maritime College. They also set up a series of training modules for the personnel. This slide shows the structure of the crew. The FPSO superintendent or the OIM, and then process personnel, technical personnel and support services. All these personnel are multi-skilled. They have marine and boiler backgrounds as well as process experience.

This slide shows some of the core competencies recognized for the training of the personnel and they cover a wide range of topics. There are at least 60 competencies we recognize. This slide shows the performance criteria for the competencies. There are a whole series of topics identified and tasks. Over here on the slide each person was assessed on the evidence, witness testimony was taken, direct observations of performance and observations of simulations were made, and personnel were questioned. These were all documented. With a small crew like this, it is essential to make sure that all staff are appropriately trained and competent.

Thank you.

MR. SALAS: Ladies and gentlemen, good morning. My name is Daniel Salas and I work for Pemex, the oil company in Mexico.

The first thing is I would like to thank the MMS and the U.S. authorities for this invitation. Now, I will talk about the FPSO in the Gulf of Mexico.

First slide take a quick review of the Mexican experiments and FPSO experiments. We start in the eighties with the MESSINIAKI FLOGA. This is a picture showing the MESSINIAKI FLOGA. Then we moved to the offshore terminal, export terminal, the VENTURE EUROPE, from March '82 to September '87. And then we have a storage, the biggest tanker in the world, the SEAWISE GIANT, 560,000 from '83 to '86. And then finally the Texaco VERAGUAS vessel replaced the VENTURE EUROPE. Let's have a quick review of the (inaudible) -- in '96, Pemex started expanded plan of the field which was called the Cantarell Field. The intention was to increase the production rate from 1.4 to 2.4 in the long term and also to increase the safety in the installation by (inaudible.) The programs include (inaudible) and also the construction of the new infrastructure required for the (inaudible) -- of the additional production.

This sketch shows the oil field in the offshore Mexico. This is the Cantarell Field. It is located in one of the biggest oil fields offshore in the world. And the adjacent fields (inaudible) -- this is the terminal where we have the onshore storage capacity. We transport through three lines and we have also here the offshore export terminal. We start development of the project with the considerations for -- the FPSO has to meet the following requirements, which is survive to a hundred year storm, to have the minimum capacity of 1.75 million barrels. We have to consider also the location, the water depth and the conditions for the adequate mooring system. Also, we have to analyze the use of existing tankers or new build.

In case of an existing tanker, we have to consider the age of the vessel, also the production rate requirements, times allowed. The FPSO has to have the capability to perform simultaneous (inaudible.) We will consider also the type of the mooring system selected and the flexible risers for this project. In '96, the intention of this is to show the existing FSO has been in operations with internal or external turret, and we show apparently in 1985-86 when the permanently moored systems starts to work around the world. For the location of the FSO after several considerations, we recommend to install the FSO 30 kilometers away from the production platform, basically outside the field. This line shows the restricted area for the field and we are just outside of there.

To have in this area the FSO, we are saving some energy in transportation costs and we have found in this location in 75 meters what is required for the optimum performance of the mooring system. For make sure we have a tanker available for this project, we look at the tanker register book and we find that between '74 and '78, tankers which will have the capability to provide the storage capacity were between '74 and '78. Most of them were in this period. The concept for these vessels basically consider to receive production from the platform, to come up through the flexible risers, internal or external turret, internal mooring, and to have ability to offload in tandem and side by side at the same time. This is just an example of the internal turret mooring system and in this specific case (inaudible) or to select the permanently moored external turret. Also, for the high grades considered by the design, almost 800,000 barrels a day to receive. We also consider the experience around the world using the flexible risers. We found on all these projects we got successful operations and no problem. Also, now all the FPSOs and FSO systems are installed around the world in the North Sea, in the South China Sea, in the South Pacific, New Zealand, in Europe, Brazil, and west of Africa, and all of them installed in a water 120 and (inaudible) -- so it doesn't -- (inaudible.)We'll take a look at this table to show you. This is a new one in the South China Sea. It was installed by the owner on March '97 and just six months later super typhoon, was considered as a super typhoon came to the area. These are the design criteria for this FSO and these are the real numbers, what they have during the (inaudible) -- the vessel has a very successful performance and the most for containers and insulating piping and steel piping of that. For the strategy of the contract. This is the scheme of the contract. It's a VOO contract, which is a will honor and honor contract. The owner will involvement capital investment. He will invest for 50 years and he makes a maritime -- (inaudible) any finance will be on your risk consultant. One of the various requirements for this program is (inaudible.) It's allowed (inaudible) and this is during the stronger requirements of the operation. In order to achieve the -- (inaudible) there are extra thickness in the piping and also a very well (inaudible) maintenance program. The next picture would show the history of the conversion in the ship yard. Once again, in order to meet the tremendous requirements for pollution, it was no other way to achieve that to convert an existing tanker. This is the schedule for 12 months after a working contract. This picture shows the rest of the conversion and it's starting the turrets for. (Inaudible) here is the preparation for the installation of the stern thrusters which we found later very successful measure to ensure during the rough weather for the mooring system to approach the --Those are the propellers. The turret installation procedure, the metering systems, we have one metering system for incoming oil and two on separate system for side by side. The arms for side by side offloading. This sketch show the conventional tanker. They use the (inaudible) -- in order to meet the technical requirements for the simultaneous operation loading and offloading, we basically put independent systems. This is a manway on deck for incoming oil and a separate system for the offloading system. The construction and conversion were completed in April of '98. After successful sea trials and the necessary certificates for navigation, the vessel sailed itself all the way until the Gulf of Mexico. This line shows the economic (inaudible) -- and we stop here when we decommissioning the propulsion system and the steering gear system also in order to meet the Mexican law. And then the vessel was (inaudible) -- to review some topics, the FSO has -- (inaudible) in tandem, we have double cargo hoses for the offloading system. The owner is a member of ITOPF and also (inaudible) according with payments policy, the owner has on board recovery system, the capability of 72,000 barrels and this is calculated based on seven minutes, which is the worst case it will stop everything since the production platforms. For the offloading system, once they are connected in side-by-side operations and do the different motions for rough weather exceeds the set point of the tension already calculated and before we come to disconnect, the system will stop up -- (inaudible) the run all the way back before the disconnect can come. And operation of the FSO is we start operation (inaudible) this is a picture performing basically all what the FSO can do. It is receiving oil and making offloading operation in tandem and side by side.

The operation for this FSO are the following: The maximum rate for incoming oil is 800,000 barrels a day. The normal operation the FSO receive 350,000 barrels a day. The pressure, the inside pressure is 75 kilograms and the normal operation is 17 kilograms. For tandem offloading operation, we have the capability to moor vessels between 50 and 350 thousand, and to offload 55,000 barrels an hour. For side by side, we can moor vessels between 15 and 50 and 250,000 dead weight tons and to offload 80,000 barrels. If we do that simultaneously in tandem, we will only, and this is due to the pressure drop, we would be able to offload 40,000 barrels an hour and we will keep same in the side by side. The operational history. The FSO starts operations in '98 and these are the tables showing numbers. 12 million barrels exported by this FSO in December of '98, offloading 21 vessels. In the last year, being '99, they offload almost 40 million barrels. And until April 2000, they have offload 18 million barrels. All these operations has been performed and successful manner with no accidents, incidents, with no spills. We have continuous in that. The FSO Ta'Kuntah is the first moored FSO in Gulf of Mexico. She has the capability to perform offloading operations in swells of 15 to 17 feet. It is the biggest after one installed in Yemen and the other one in Columbia. Ta'Kuntah is the second FSO in operation. She has involved the most technology in industry. She has the biggest metering systems that's been installed and the highest reception for incoming oil, 800,000 barrels a day. That's all I have for you. Thank you very much.

MR. TUNTLAND: Thank you very much. Thank you for inviting me to this session. Good afternoon, ladies and gentlemen.

I will first say a few words about the petroleum resources offshore Norway, the climate, as well as the Norwegian petroleum legislation. Then I will move on to the application of FPSOs on the Norwegian Continental Shelf. At the end, I will share some experience we have had with our FPSOs. I expect to use the time I have been given, so if you have any questions, please wait until the end of my presentation.

(It was requested Mr. Tuntland's prepared paper be inserted here rather than his actual speech, as follows.)

In the early nineties, the oil exploration on the Norwegian Continental Shelf moved into deeper waters, further away from existing infrastructure like pipeline systems. This fact, together with cost competitiveness, called for floating production and storage concepts. A natural choice was the FPSO with its flexibility with respect to water depth and advantageous storage capacity. The Norwegian petroleum production in 1999 totaled 1.062 million barrels of oil, 45.5 billion Sm3 gas and 10 billion tonnes of condensate. Average daily oil production was 2.91 million barrels, which ranks Norway as number seven among the world's leading oil producers and as number three among the world's leading net crude exporters. The estimated value of the Norwegian petroleum export in 1999 was equivalent to $19 billion. Cumulative output since petroleum production began in 1971 comes to 2.7 billion Sm3 oil equivalents, which represent approximately 21 percent of the total expected recoverable resources. Discovered petroleum resources are 9.6 billion Sm3 oil equivalents, while in addition comes undiscovered petroleum resources estimated to 3.7 billion Sm3 oil equivalents. This sums up the total petroleum resources on the Norwegian Continental Shelf to roughly 13.2 billion Sm3 oil equivalents. Norway's gas export totaled 45.5 billion Sm3 in 1999, which represented approximately 2 percent of the world's consumption. Norway ranks among the world's top 10 gas exporters, and Norwegian deliveries account for 10 percent of the gas consumption in western Europe. At the end of 1999, 46 fields are in production on the Norwegian Continental Shelf. In association with these fields are 106 installations, divided into five floating production, storage and offloading ships, six floating production semi-submersibles, of which one is made of concrete, three floating storage and offloading ships, two tension leg platforms, one of which is made of concrete, one production jack-up, 75 jackets and 12 concrete gravity-based installations. In addition, there are 108 subsea installations. 24 drilling rigs and vessels are engaged on an annual basis. 9300 kilometers of pipeline have been installed to transport crude oil, condensate and gas to onshore facilities in Norway, Great Britain, Germany, Belgium and France. During 1999, 28 exploration wells (18 wild cats and 10 appraisals) and 150 development wells were completed or temporarily abandoned. The forecast predicts a decline in oil production during the next decade. To minimize this effect, we have in the recent years aimed at encouraging discovery of petroleum resources. The effort has been concentrated on finding resources near existing infrastructure and on testing new exploration models. Substantial undiscovered resources are thought to remain on the Norwegian Continental Shelf. The North Sea is the most explored part of the Norwegian Continental Shelf. The geological understanding is good for most of the area. Even small discoveries may have a good profitability if these facilities are used in a rational way. The North Sea will probably be a core region for future exploration, which could also be extended to less known parts of the area. Great interest is focused on exploring new areas of the Shelf. Some of this acreage, the More and Voring Basins in the Norwegian Sea, involves water depths down to 1500 meters. During 1999, a dry exploration well was drilled on Gjallarryggen in 1352 meters water depth, which represents a new record on the Norwegian Continental Shelf. But some major parts of the Shelf have not been opened for exploration drilling yet, such as Skagerak, Lofoten, Vesteralen and the waters surrounding Spitsbergen and Jan Mayen, as well as in the Barents Sea, etcetera. Since Norway is a small country far away, it may be appropriate to look at the size of my little country. The distance between the northernmost and southernmost points in Norway is 1752 kilometers. Norway's coastal line, with its fjords and islands, represents approximately 57,000 kilometers, and the acreage is 387,000 square kilometers, including Spitsbergen and Jan Mayen; in other words, slightly less than California's 405,000 square kilometers. The size of the Continental Shelf is by comparison 2 million kilometers. The environmental climate in the Norwegian sector is rather harsh. This means that structures are more exposed to fatigue than, for example, in the Gulf of Mexico. Wave heights having a 100-year return period are typically between 25 and 30 meters. The ocean currents, however, are small for most of the Shelf. We are at present in the process of rewriting our regulations. We plan to issue them early next year. At present, we have 13 regulations, in addition to the state pollution authorities and the health authorities having their own regulations. All the regulations from the three authorities are to be merged into four new regulations. The new regulations will then supersede all the existing regulations. In content, the new regulations will be functional. By functional we mean that requirements will be specified by features, characteristics, process conditions, boundaries and exclusions defining the performance of the product, process or service. This also implies that the vast majority of detail requirements are removed from the regulations, for example, we are performing a major deregulation. Pertaining to the regulations, we will issue a guideline listing standards which we recommend. These recommendations will mainly be based on the NORSOK standards. The NORSOK standards are industrial standards developed by the petroleum industry in Norway in a similar way as the API standards have been developed in the USA, but we will also give options to use other recognized rules, codes or standards. The functional requirements in the regulations are fulfilled by following the listed standards. The Norwegian regulatory requirements to manning of the maritime functions on board FPSOs are based on the Norwegian Maritime Directorate's requirements for personnel on board mobile offshore units. This means that control room operators taking care of maritime functions and operations are to have a similar knowledge within the relevant maritime areas as is required for control room operators on board Norwegian registered mobile offshore units. Personnel with higher maritime competence is also required on board. FPSOs can operate in wide ranges of water depths compared to fixed installations. In Norway, we have FPSOs working in water depths from 126 meters to 338 meters. Another advantage of FPSOs is the storage capacity. FPSOs do not need to be connected to already existing infra structures such as pipelines, as they have their own storage facilities and offloading facilities. As a third advantage, FPSOs can be built and equipped worldwide and towed to location. This means that FPSOs can more or less be built where price and quality are best at the time of contract award. Of course, also the rapid development in subsea and well technology areas, as well as the flexible riser technology, have worked in the direction of FPSOs. The first purpose built FPSO on the Norwegian Continental Shelf was the PETROJARL I, which entered into operation in 1986. PETROJARL I had a production capacity of up to 30,000 barrels a day and produced from one well. The storage capacity was 180,000 barrels a day. At the moment, PETROJARL I is not working in Norway. Today Norway has five FPSOs in operation. As storage units, Norway has three FSUs and one more FSU is due to come this year. The NORNE FPSO entered into operation in November 1997, followed by VARG 1998 and JOTUN, BALDER and ASGARD in 1999. The FPSOs on the Norwegian Continental Shelf are all turret moored. All of them are weathervaning, which means that the turret is located in the forward half of the ship, and waves and wind will keep the FPSO with its bow towards the weather. To help it to stay on a steady controlled course, the FPSOs are equipped with thruster assistance systems. Normally the master on the FPSO finds the best heading with respect to waves and wind, for example, the heading giving the smallest movements and the best working conditions for the processing of the crude oil. Often waves and wind come from different directions. Due to required natural ventilation in the processes area, it is normal to keep the wind in a slight angle to the bow and the waves more on the side of the bow. Because of the good motion characteristics of the FPSO, shut down of the production due to motion of the process with respect to equipment is not regarded as a problem. In Norway, offshore loading started from articulated columns at the Statfjord Field in 1979. The shuttle tanker was moored to the column with a hawser, but also had some thrusters assistance. The crude oil was transferred to the shuttle tanker with a loading hose. More or less the same technology is used for tandem loading from FPSOs or FSUs. The shuttle tanker is moored to the aft end of the FPSO and, in addition, the tanker has a dynamic positioning system. Typical distance between the two ships in operation is 75 to 80 meters. Of course, the hawser and the loading hose are some meters long. For use in an emergency, the shuttle takers are equipped with an emergency release so the captain on the shuttle tanker can disconnect from the FPSO and leave without oil spill.Offshore loading gives the freedom to the owner of the field to deliver the oil wherever he wishes. This can be a good solution for a license with more than one owner. The different owners may then use their own refineries.Only a few days in the winter season the weather is so severe that offshore loading is not possible. But because of the storage capacity, the production has to be reduced or stopped only a few times for waiting on weather.I will now briefly mention some challenges experienced related to FPSOs.As FPSO experienced a ver sudden 180 degree change in wind direction last year. The change occurred so quickly that the FPSO was unable to turn fast enough. Thus, the ship ended up with its tail towards the wind. There was some uncertainty as to whether the thrusters would keep the speed of rotation low enough to enable the turret to follow the rotation in order to avoid twisting the anchor chain when turning the FPSO against the wind. Other uncertainties which had to be considered was whether the thruster power was sufficient to turn the FPSO 180 degrees under the existing weather conditions, as well as whether the maximum tension in the mooring chain would exceed the allowed tension when the ship turned its broad side towards the wind. The turning of the FPSO was delayed for a few hours until the weather had calmed somewhat. Keeping the tail towards the wind, however, did not present a problem.There are, as previously mentioned, five FPSOs on the Norwegian Continental Shelf. Four of these vessels have experienced green water or heavy sea spray causing damage to equipment. Different actions have been suggested and implemented to prevent green water damages. These actions can be divided into two main groups: Physical protection like raised forecastle, wave-breaking walls or local reinforcement of equipment and structures; operational restrictions like reduced draft, change in static trim, and restrictions with respect to personnel in green water zones.Green water is regarded by NPD as a safety risk for the following reasons: It may be a threat to people staying in the green water zones; living quarters can be damaged in such a manner that people inside may get injured; damage to equipment which is critical with respect to safety may occur.Statements from the operators of the production vessels also indicate that green water may lead to shutdown of production as often as on an annual basis.Last week, during the ISOPE conference in Seattle, a paper summing up our incidents, experience and views on green sea was presented.One of the major challenges with regards to the flexible risers on an FPSO is how to perform a proper inspection and condition evaluation.The Norwegian regulations require annual inspection of all pipeline systems by the most suitable method available at any time. The inspection of flexible risers on FPSOs is made very complicated by the turret, the risers guide tube and the end fittings. In addition, flexible risers have a complicated composition with different layers and materials, making methods for inspections a challenge. There are at present no proven methods for inspection, but a few methods are close to being accepted.An FPSO was hit by a shuttle tanker this year. Damages to the FPSO were limited to local dents at the aft end and the flare tower. The collision was caused by a combination of three factors on board the shuttle tanker, a small error in the DP logic and/or erroneous operation of the DP system together with lack of awareness.Shortly after arrival at the field in the North Sea, extensive cracking of topside coating was revealed on an FPSO. Cracking as much as 60 percent in extent was observed on piping, structures and auxiliary equipment in three modules. The phenomenon has been discovered at several installations, both off and onshore, coated with similar coating and thereby representing a major challenge in respect of maintenance. The main reason for the cracking has not been identified yet.A joint industry research project regarding fatigue capacity internally in FPSO hulls is being headed by the Norske Veritas in Norway. Since FPSOs in general are supposed to remain offshore without interruption as compared to ordinary ships which can be docked every fifth year, it is important to prevent occurrence of fatigue cracks in the internal details of FPSO hulls. The project started in 1998, and the objective is to calculate fatigue lives for various connections and verify the calculations by tests. Thus, unfortunate shapes of connections can be avoided.To summarize, we have a large continental shelf. We have found and still expect to find major petroleum discoveries in the future. We therefore see a future for FPSOs in Norway. We are in the process of revising our regulations. Our present use of FPSOs has revealed new challenges with respect to safety. And as the next speaker is from the Health and Safety Executive in the U.K., there is to say that we have a close cooperation with HSE.)Thank you very much.

MR. MILLS: Good afternoon, ladies and gentlemen. My name is Peter Mills. I'm a principal inspector of the United Kingdom Health and Safety Executives Offshore Division based in London. It is my pleasure this afternoon to share the U.K. experience with FPSOs with you. During my talk this afternoon, I'd like to go through the background of the current legislation in the U.K., to describe briefly what that current legislatory regime is, explain importantly how an agency goes about its business as a regulator. I'll also mention the U.K.'s track record to date and identify some topical safety issues and how they have currently been taken forward, and finally offer a few concluding remarks. (It was requested Mr. Mills' prepared paper be inserted here rather than his actual speech, as follows:

The current regime of offshore safety legislation in the U.K. is largely based on the recommendations made by Lord Cullen in his report on the inquiry into the PIPER A disaster in the North Sea in July 1988. Those wishing to understand the rationale for the current offshore safety regime in the U.K. are strongly recommended to read the report.Amongst other things, Lord Cullen was concerned about the reliance placed on compliance with prescriptive regulations and guidance. This had been criticized by several witnesses at the inquiry. He recommended a shift away from prescription towards more explicit consideration of hazards and risks by those creating them, for example, the owners and operators of offshore installations. He recommended replacement of the prescriptive regulations by "goal setting" regulations, which would leave owners and operators free to devise the most appropriate safeguards on a case-by-case basis. The centerpiece of the new regulatory regime was to be a safety case for each installation describing the specific major accident hazards and the associated risk management arrangements. The recommendations were accepted in full by all interested parties and the reforms were implemented by the HSE when it assumed the responsibility for enforcing offshore health and safety requirements in early 1991.The principal regulations applicable to offshore health and safety are as follows:Health and Safety at Work, Etc., Act of 1974 via the Application Outside Great Britain Order of 1995; the Offshore Installations Regulations of 1992; the Offshore Installations Regulations of 1995; the Offshore Installations and Pipeline Works Regulations of 1995; and the Offshore Installations and Wells Regulations of 1996.These regulations apply to the entire life cycle of an installation, from design through to operations and abandonment. The requirements for mobile installations differ slightly from those for fixed installations, but floating production and/or storage units are defined as fixed installations for this purpose; although there have been some exceptions for essentially mobile or temporary floating production or storage units.In essence, the safety case is the duty holder's written documentary evidence demonstrating that his management system is adequate to ensure that the relevant statutory provisions will, in respect of matters within his control, be complied with in relation to the installation and any activity on or in connection with it; he has established adequate arrangements for audit and for the making of reports hereof; all hazards with the potential to cause a major accident have been identified; and risks have been evaluated and measures have been or will be taken to reduce risks to persons affected by those hazards to the lowest level that is reasonably practicable. With the exception of the safety case for design, all other cases are subject to formal acceptance by the HSE. Installations cannot be legally operated without an accepted safety case. As with other regulations, they are accompanied by guidance that is intended to offer a practical interpretation of the legal requirements. More recent developments have introduced a requirement for the verification of safety-critical elements by an independent and competent person. This replaced the earlier certification requirement for installations. Experience with safety case assessment indicated that further guidance was required on HSE's expectations, and this led to the publication in 1998 of "Assessment Principles for Offshore Safety Cases."Our mission statement is: "To ensure that risks to people from work activities in the upstream petroleum and diving industries are properly controlled." We seek to achieve this through enforcement of health and safety law, and more generally by promoting improved standards of health and safety across industry.

The former involves case-specific work: Assessment of safety cases; inspection of duty holders/installations; investigation of accidents and incidents; and enforcement activities.The latter involves generic work, including: Research; participation in standards development, for example, ISO and IMO; and working with interested parties to identify, describe and promote good practice.HSE also collaborates with other regulators, for example, North Sea Offshore Authorities' Forum, International Regulators Forum, and individual regulators such as the Norwegian Petroleum Directorate.The regulations have largely succeeded in bringing about the changes envisioned by Lord Cullen; for example, explicit consideration of risk rather than reliance on prescription, and improved management and ownership of health and safety by duty holders.This view is supported by an independent review recently undertaken by Aberdeen University Petroleum and Economics Consultants Ltd. This involved wide consultation with interested parties, not the least of those working offshore.It is worth noting that goal setting and prescription should not be seen as conflicting, but as largely complementary. Prescriptive standards continue to make a major contribution to achieving safety goals, but can no longer be assumed to be fully appropriate or sufficient in every particular case. Currently, there are 16 FPSOs, including two floating storage units, FSUs, operating on the U.K. Continental Shelf. The majority are situated in the Central North Sea. Two are located to the West of Shetland, and one is located in the Liverpool Bay area. The sizes range considerably from 32,000 tonnes to 200,000 tonnes displacement, and the average of 120,000 tonnes corresponds to the size of a typical medium crude carrier. They are generally either tanker conversions or similar new hull designs. Analysis of FPSO accidents and incidents reported to us over the last four years shows that there have been no fatalities involving FPSO operations, 12 accidents implying hospitalization, 66 lesser accidents involving three days or more off work, and 182 incidents classed as dangerous occurrences. These figures are similar to that of other offshore installations. Of the dangerous occurrences, approximately one-fifth can be attributed to FPSO-specific systems, for example, turret area, shuttle tanker collision, moorings or adverse weather.

We inspect offshore installations and duty holders, and investigate accidents and incidents. For the most part, any necessary improvements are obtained through the provision of advice and guidance to duty holders. However, where we find significant breaches of the law or situations posing imminent danger, we can issue formal enforcement notices. Some such notices have related specifically to FPSO operations, for example, vessel stability and shuttle tanker operations. However, we recognize that our experience to date with FPSO operations is relatively limited. We have, therefore, identified improvement of FPSO safety as one of our primary objectives for the next three years, and within that we have a specific aim to improve the safety of shuttle tanker operations to reduce collision risk. Our experience to date of FPSO safety in the U.K. has enabled us to identify a range of FPSO- specific safety issues which are also widely acknowledged by FPSO operators and designers. In summary, these are process system safety, fire and blast risk, mooring and positioning integrity and/or failure, environmental loading, green water and wave slam, structural integrity, stability and seaworthiness, marine systems generally, shuttle tanker collision risk, metocean forecasting, helicopter operations, motion responses and habitability, competency, evacuation and escape, and human factors. We have a major safety-related research program, much of which we sponsor jointly with industry. Current FPSO research in the maritime integrity field includes green water loading, collision risk, FPSO motion responses and the effects on people, hardware and activities, and station keeping and mooring systems. Almost all of our research is openly reported. Details are to be found in "Offshore Research Focus," which is available on the Internet. We are also taking action to make the reports available on the HSE website. HSE also publishes papers at national and international conferences such as the recent paper to OTC concerning FPSO structural integrity. Green water is the occurrence of unbroken waves exceeding the freeboard at the bow, side or stern of FPSOs. Until recently, it was believed that only the bow region was exposed to such conditions, but recent events or incidents have shown the vulnerability of FPSOs to side and stern inundation, depending on weathervaning attitude. Further, it has been observed that waves of lesser magnitude than the design maximum can cause significant green water events. Other related incidents relate to wave impacts on the bow structure itself. HSE commissioned research into green seas with British Maritime Technology. Their report concluded that the occurrence of green water on deck could not be reliably predicted using present day methods. HSE then participated in the MARIN green seas JIP that sought to provide information about the green water occurrence and loading so that it can be incorporated into the design of FPSOs. One deliverable from this JIP was the software tool "Greenlab." HSE commissioned consultants Bomel to assess all U.K. FPSOs using the tool Greenlab. The results have all been subject to independent verification by MARIN. HSE will soon be discussing the implication of the results with all U.K. duty holders.In this, as in other areas, initiation and participation in joint industry projects has been a key to success in improving knowledge, cooperation and safety.Safety cases have been used in the U.K. for some time as a technique to help focus the management of risks in the major hazard industries. There is sufficient experience to be able to form an overall judgment on their benefit in the offshore sector.FPSOs are not simply ships with process equipment on deck when on station. Explicit consideration of risks for each individual application is required. Prescriptive requirements may not be sufficient. There is a continuous learning process, and duty holders may need to reassess their installations as new knowledge becomes available. Goal setting legislation can facilitate innovation. The safety case is a suitable vehicle for this process.)Thank you for the opportunity to discuss my experience. That concludes my talk and I wish everyone a successful workshop. Thank you. (Applause.)