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Submersibles - keeping everyone safe through operational standards

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Chairman—Tork Buckley

[Recording started late]

.....and the latest toys are submarines and submersibles. Just one little problem there. Toys, they're not. So what we're hoping to look at in this session is why they're not toys, if you're not already familiar with that—and also how we can move to create an environment of safe operation of these fascinating but potentially hazardous machines. Will Kohnen is going to kick off, so over to you. No—Richard is going to start.

Richard Boggs Camper & Nicholsons

Good afternoon, thanks for coming. Bear with us, a little technical difficulty. Anyway I'm Rick Boggs, I'm technical superintendent for Camper & Nicholsons, and if you're wondering what Camper & Nicholsons has to do with submersibles, Campers is about the largest of the yacht management companies and we got to be the biggest by leading the industry. We paved the way to the development of luxury yacht charter, we established the standards of the charter as well as owner services, and we got where we are because we kept ahead of the industry and we lead the industry. And one of the things that we see in the future—it's surfaced on our horizon—is the application of recreational submersibles on large yachts, and especially charter yachts. And the first thing we noticed about these things as they're being sold and marketed, is they're being marketed as a yacht toy. And they are far from being a yacht toy. But they bring a new dynamic to the charter market—placing a submersible on an already spectacular yacht, it's a recipe for charter experience that is hard to duplicate anywhere. It really capitalises the 'E' in 'exclusive'. And while boats get bigger and bigger every year, the biggest one this year probably won't be next year, but a charter yacht with a submersible on board is going to be a yacht that's remembered and is going to sell charters. So we're all in favour of getting submersibles onboard large yachts. But—and here's the but—the safety and success of adding a submersible to the stable of attractions depends on the safe and practical integration of that submersible onto the yacht and with its crew. And practical enters into this as a matter of safety. I've got a few lines on my resume devoted to submersible operations—about 10 years of driving manned submersibles in the oilfields in the commercial side of the business—and we have a 30 – 40-year history of successful and safe operations. One of the reasons for that is the submersible operated by a dedicated, devoted crew of very highly trained, highly skilled and highly experienced operators. And this is something that we don't have in the yacht

industry. We don't have that core of people with the background and the skills to operate these things on yachts. We're already facing looking at needing 6,000 new crew members in the next few years. We don't have the people available and we don't have the depth of experience in the yachting industry to help support these things the way we have to, to keep them safe. One of the things that contributed to our safety record in the commercial industry was we operated from dedicated support ships. They were very well equipped vessels, they were well suited for handling submersibles, most of them were built just with that intention, solely, and with the lifting equipment. They've done an excellent job of managing the operational side of the business. The tourist submersible industry—it's always used as a guide right now for the success and safety of manned submersibles—has carried more than 30million passengers. But that tourist submersible industry isn't really the guide that we should use, or the measure that we should use when looking at placing a submersible on board a yacht. It's a shore-based operation, it has a dedicated crew, which does nothing but operate that vessel in a single area, whereas putting a submersible on a yacht, we're talking about having 2 or 3 people who have other duties on the yacht moving from place to place in areas where they may never have dived before. The regulators are pretty much staying out of this. I can't speak for them for it's a safe assumption that they recognise the processes we used in the commercial operations, our process of selection and training of crews and the operation of the vehicles evolved naturally to the point where a greater level of external guidance wasn't required. Most of the regulations that do exist in submersibles right now are fairly simple, they don't dictate how the submersible should be operated, they might just dictate that it be operated in some safe manner and the question that first arises—are the regulations good enough, do we need more? And why do we need more? Well, I'm not here to ask for more regulations, we're trying to avoid them as a matter of fact. And some of the comments that were made yesterday—I'll point to this—is self-regulation is needed, there should be an industry-driven standard, and we need to come up with a set of best practices that flag states can verify and if they accept it, they can use this as a future guideline. The regulations were written for work boats or shore-based tourist submersibles, and they're perfectly adequate for the existing commercial operations. But the peculiarities in the yacht industry, some of which I referred to at the beginning, and that we don't have—dedicated highly trained crews—few people on the yacht are prepared, trained or equipped to handle submersible systems and have to have a tremendous reliance on the submersible manufacturers for support. So one of the things I'm concerned about is that, unless the yachting industry in conjunction with the submersible manufacturers and working in conjunction with flag states, can come up with a set of guidelines, which help to serve both the builders and the yacht owner and most importantly of all, protect the charter guests, we could end up with a 1000lb gorilla coming down with a set of regulations that none of us can work with. And we do have this opportunity, we started conversations with the submersible industry last year, in developing a set of industry standards, guidelines that we can adopt in the yachting industry to help promote this idea. The International Superyacht Society has agreed to provide a forum or platform for us in the setting up of a technical sub committee taking input from the yacht industry, from the submersible industry, from flag states, to help develop an industry standard, a best practices document, that we, as yacht managers, can provide to owners and charter marketing people and builders as well with a set of guidelines. If you want to put a submersible on a yacht, these are the guidelines and standards that, if followed, should satisfy flag state, port state, and most important of all, insurance company requirements for safety and reliability. One thing I'm worried about is, let's not repeat the broken promises of the 50s. The way they're selling some of the submersibles into the markets now, they're offering—we can teach you how to drive it in a day, put this thing on the back of the yacht and

carry it away. I don't want to see that happen with submarines on yachts. These things are—the recreational submersible has got to be one of the greatest things that ever could happen to some larger yachts in some places, and I think we're capable of managing it well enough to avoid this dream we had here. I think we can do that. Some of the boats that are out there now are just spectacular. They will turn a fantastic charter into a charter beyond description. The different types—here's one of Graham's little beasts here! Anyway, what we're looking for, and what I'd like to see and get started rolling here, is input from the industry, from owners, builders, managers, we've got it from the submersible manufacturers, is to give us input into this sub committee, ideas on what we should do and how we should do it, what we need to do and what we might want to avoid in making this thing work. We're trying to establish the baseline standard—it's safety-based, safety is the greatest issue and we want to satisfy flag and class and for the insurance company to manage the risk so that we can afford to keep these things on board yachts. We'd like to outline the operational and the safety issues. We need to have a set of operational guidelines. But, right now, there are probably 10–15 linear feet of construction and technical standards for submersibles. There are probably 50 pages of IMO, MCA, U.S. Coastguard and other flag state documents that cover the operation of submersibles, but none of those pages apply to the operation of submersibles *on yachts*. That issue has yet to be addressed. And that's where we'd like to start out today, is to outline the operational and safety issues. Establish manning requirements and characterise reliability issues. We need to let a yacht owner know what he's getting into, putting a submersible on his yacht. And what to look forward to, and how to maintain these things. That's my part of it. Thank you.

Tork

Thank you Richard. Will ?

Will Kohnen Marine Technology Society Committee on Manned Underwater Vehicles

Well, good afternoon. We'll see if the right presentation comes up! I'll follow up on Rick's presentation and a couple of introductions first. I've got a day job, which is as President of SEAmagine Hydrospace—we build submarines—I've got a second unpaid job which is chair for the Marine Technology Society—we have a manned underwater vehicles' committee and it's all in fostering industry cohesion. And Rick came over some time last year and figured 'you know, as a yacht management company, we've got some issues here'. Which way does it go? I've got a short presentation I'm going to run through, a few slides, however before I get to the meat of some of the questions we want to talk about at the end, I think a little introduction is appropriate. Because when you bring up the issue of submarines, it conjures up many different types of pictures. I think the first question is, why are we here as a manufacturer within the yachting industry—it's an investment in time, there's a lot of organisation and why do we want to talk about these things? First of all, we're here as a company because we sell submarines. We think people want them, they're going to be out there, submersibles are very appealing, especially in the superyacht market, the demand is increasing, we've been doing this for 15 years before this was really popular on yachts and we can feel the change, the questions that are being asked. And the bottom line is, submersibles are sophisticated systems. Rick mentioned yes, people think they're toys, everyone likes to think you can use them like toys, but there's a lot of work that happens behind the curtains. And bottom line, we're here because we know owners want to do this. There's no way of going back. And they just want to go and look at things. They want to film things, they want to record it, they want to have fun, they want to experience the awe of sitting in the

deep blue, they want to see these fish around and they want to take their friends. It's a one way street. Once you've been there, there is no going back. Well, about 15 years ago, when we kind of figured we wanted to do this submarine work, you had some basic options. You had the very basic and you had the very complex. Which essentially is—the research industry is pushing these types of vehicles, and we figured there's room for a standard product line. And what we build at SEAmagine is a standard product line of modern hydrocopters—they're underwater helicopters, we make them two man, three man, which means pilot and passenger or two different occupants and we build them anywhere from 500 – 3,000 feet deep. So 3,000 feet, they're very sophisticated submarines. As a company, we design, fabricate, we do end to end. We do the design, analysis, construction, all the certification, it's patented technology, after 15 years you kind of get around—we do work ABS—they're ABS class design, they're Cayman approved, we've deployed to date 7 submarines, in 6 different countries, and 4 of them are operating off ships. Lots of different stories for each one. But like someone mentioned yesterday, how do you get there? Well, you just stick with it, and you work out through a lot of details. We do ABS survey, we do testing, everything gets done in-house to provide a field-tested, sea-trialled vehicle, with full registration, ready to deliver to the client. Show up at his door. Well, then he's got the submarine. Crew training is really important—crew issues are huge, we do full pilot training, we control the pilot certification, we provide maintenance training, and essentially, when we've finished with the crew, we do expect crew to be able to be self-sufficient in maintaining the vehicle with technical support from headquarters. We've trained about 48 pilots to date, our training programme dates back to about 1998, when we ran our first submarine for commercial use for tourism in California, and the coastguards said 'well, where are your captains' licences for your pilots?' Which were non-existent. And we basically developed the programme, generated a brand new limited master's licence for captains of small submersibles and it is a programme that we've carefully nurtured forward. It was approved in 2000 in Cayman as it followed the different deliveries we had in Turkey, Australia, Costa Rica and Europe. It's a progressive evolutionary trust that you have that all these flag states can't really be wrong and you're doing something right. There is the issue of yacht integration, the manufacturer has to support the technicalities and complexities involved in integrating it into a yacht, technical support and long-term life cycle management of the vehicle. Now, none of this is required by law, there are no formal requirements but this is generally a very good idea. We do believe the industry will grow, everybody believes it will grow, part of the issue is, what do we need to make sure it does so in an orderly fashion? Rule no.1 from yesterday, and we do believe it, is the owners. You've got to keep them happy. They don't want to know all this stuff. They just want to sit in there, have fun, come back and talk about it. Which is where they have the issue of a toy, and it leaves it up to everybody in this room to make this stuff work behind the curtains. It does require trust, we have to build that, it requires an industry professionalism overall, it requires process control and third party verification. Other than that, it just sounds contrived. Education is a huge issue, because you're setting expectations, you've got people selling these things and making promises, an intra-industry dialogue is really important. Especially when there are people building submarines and people building yachts and they've got to come together somewhere. The knowledge exchange is very important and the bottom line is, we cannot run this on a buyer beware process of well, you know, the owner should have read the small print and it's his problem. It just doesn't work. Credibility—the exercise of self-discipline for quality assurance—you know, it sounds altruistic and all that, but that's the bottom line. If we want to keep the 1000lb gorilla out of here, we've got to watch out. Self-regulation for safety requirements—it essentially comes down to an industry best practices set of standards. I took the risk of putting a big chart on there—basically there is a certain road path—we had this

presentation at the submarine conference in January to bring this up with the submarine manufactures—there are a lot of concerns, what kind of rules are you trying to change? And the bottom line is, we're not trying to change rules. There are several processes in here that are parallel between us as a submarine manufacturer—we do design and fabricate the submersibles, we do a survey during construction and we come up with an ABS class vehicle ready for delivery. The yellow chart shows a design fab of the superyacht, same thing, construction, survey, testing and certification—and somehow you marry the two vehicles together to get it to the owner. Well, by the time you marry it together, there's usually a management company involved and they're in charge of doing the integration onto the superyacht, it requires a bunch of help, once it's on there you need to train the crew, and all the owner wants to know is, when do I get to go and play? They just want to go. Why is it taking so long? In terms of rules—we have two controlled processes here. As a manufacturer, either you're building a yacht or you're building a submersible. We have classification processes and the two grey areas really show we both have a class product, we have rules and codes, there is no need to rewrite rules and standards for safety on how to build the vehicles. But everybody knows you can take two perfectly good pieces of product and give it to somebody and they can come up with creative ways of destroying it. And that's really where it comes in. The integration of these two vehicles—there are no formal requirements of what you have to do. And that's really where the question is. You have an operational and maintenance training programme, you feed into it, you have technical support, you have life-cycle management, that all feeds that machine and there is pressure from the owner to just go and play. The question is, what do we do in that blue square? We're not trying to change ABS rules, Lloyds rules, GL, Cayman, but what do we do when we marry equipment ?

The yacht management issues—and that's something that comes back and it struck us when Rick was asking—look, we're going to be making promises, we're responsible to our charterers. You know, how do we manage that? The question there is really where there are no legal or formal requirements, how do we best deal with minimum safety practical standards, how often do you maintain this thing? How do you make sure the crew does it right? There isn't anybody watching and then once a year seeing if there's any big dents in the submarine. If there is no formal requirement, how do you convince the owner that he really has to pay for all these extra services to maintain it properly? I mean, he doesn't know. Maybe it's just a manufacturer trying to get a lot of money out of him. If you're just making it up, there is going to be some question about it. Three is—how can the submersible and the yacht industry define a best industry practice as standard? That's really the question here, and the same question was put to the submersible group, saying guys—how do we do this? And the answer was well, we only hold 50% of the answer, because the other 50% comes from the yachting group. If either side tries to do it in a vacuum, we're not going to have a practical set of standards. What's the answer? We're not sure. What's the first step? It's to engage the yachting and the submersible industries in a dialogue, and step 2 is to engage in the exchange, and especially make sure we trade client demand information. And that's why we're here, and that's why we figured this is something we really ought to talk about, because step number 1 is to just be proactive and do something. My last slide is really my most important slide, and why we are here. Because it's a first step or the second step of our dialogue roadmap. We have to engage, I think—as MTS chair and responsible, how do we make sure we promote the growth of our industry for submersibles—the safety issues do require for superyachts a dialogue between yachts, and submarines. We've had the conference in January in New Orleans, we hold it once a year and we invite all the manufacturers and operators of submersibles around the world to come

and talk about these issues. We have lots of different tracks, it runs for about 2 days, and we brought up that for discussion. ASF today is step 2—to bring in and introduce the dialogue here within the yachting industry and we're going to have GSF in November. The idea is to collect some of that information and pass it through, as a dialogue, through the ISS which is host, to hold a technical committee, which can collect all that information and then the invitation is really for questions, ideas how we would do that, and also volunteers within the industry and yachting industry that want to participate in that dialogue and generate these standards.

Tork

Thank you very much. Graham?

Graham Hawkes Hawkes Ocean Technologies / Deep Flight

Do you mind if I stand? I can't talk without waving my arms around. If I wave my arms here, I'll knock somebody over. OK, I'm moving to the next slide. My name is Graham Hawkes, my company is Hawkes Ocean Technologies, otherwise known as Deep Flight. Just a quick kind of introduction against some visual stuff out here. This all started back in 1930, by the way with the BB, went down to 3,000 feet and just a quick plug—I mean you're part of the superyacht industry, you've got access to 2/3rds of the ocean, but it's the surface. The ocean is a 3 dimensional place, it's on average 4 miles deep, 94% of life on earth is aquatic. It just blows my mind at all this money in the yachting industry involved with the surface when there is just so much going on beneath that keel. And our eyes were opened in 1930. The other sub down there shows kind of our end of the business—I'd like to thank—this is Shing Kai, she's currently the deepest rated sub in the world, that's not quite true but deepest operational sub in the world, it's about 21,000 feet. Just quickly to give you some idea of depth—I know you're not playing in that range but I'll show you what we were looking at. Left hand scale is the depth of the ocean in metres. The right hand scale is percentage of ocean bottom covered, and you see that, by the time you get to 20,000 feet, you've covered about 93% or 94%. If you look at the flags there and count them, 5, that's how many deep submersibles there are in the planet. There's only 5. I mean 5—how many helicopters, how many trains, how many rockets. So the owners of superyachts are going to go and play in the place where human beings haven't been. They're going to get capabilities potentially that no navy has. So the idea that these are toys just blows me away. It means nobody really understands what we're all playing with here. These are those 5 subs, and I want to show you where we're coming from. The reason there's only 5 subs, is they typically weigh in at about 50,000lbs. To launch a 50,000lb machine off your vessel and recover it again involves a dedicated yacht, a bit more than even some of the big superyachts. I think that's Atlantis that's handling for the U.S. Alvin. Here's where the deep ones—and I know we're not talking about deep ones, but I'll show you one private owner who is a little deeper than all of this—it generally is about—10,000 lbs is the weight that we took as arbitrary but it goes back to experience in the North Sea with micro submersibles ADs—we always feel if we can get under 10,000lbs, then we can hire ships—it's much easier to find a ship—there's ships in the offshore oil industry that'll handle 10,000lb load overboard and back again and there's the kind of research fleet. So we wanted to get away from this 60,000lbs, so our whole effort has been to build ultra light submersibles that go very deep, and the best place to be on this chart is at the bottom of the depth and right down here and take a look at that guy there. Just a quick background—this is the last of the conventional subs that we built, maybe the last we'll ever build—SEAmagine are doing a superb job with the all acrylic conventional sub, so I'm not sure we will bother—I think you've got that

space—so this is the last conventional one we built. It's a 3,000-foot rated deep Rover—that's James Cameron, if you see *Aliens of the Deep*, you'll see that machine. If you see a Bond film, you've seen our subs, they kill Bond stone dead in 'For your Eyes Only'. If you've seen the movie *Sphere*, you've seen some of our subs and if you watch National Geographic, you've seen lots of them. But moving on, here's where it kind of—this is 10, no maybe 15 years ago—I just got frustrated with that whole industry, it really wasn't going anywhere, it was before there was interest by this community, and I just wanted to break out of these conventional submersibles that operate like underwater balloons. They're vertical elevators with very little footprint. And we're going into this three dimensional space—the first whale I ever saw underwater wasn't stiff and long, the way they're shown in all the encyclopaedias, it was actually vertical, just resting that way. If you swim, if you dive, if you look at the animals, you look at the dolphins, they don't kind of stretch out and go stiff, they're just—it's a 3 dimensional space and we build submarines conventionally and we sit on chairs and it just cracks me up. We build submarines and we sit on chairs and we go into that space. I mean, it works wonderfully with SEAmagine stuff, you've got a helicopter, they're just gorgeous. But I wanted to get somewhere else and do something a little bit different. And that was a dream of mine—she will get built one day, she's not yet, but what we did do for real is we built a thing called Deep Flight 1—which arguably is the first underwater aircraft. It is literally that. It has some genesis—it's still got some submersible type qualities about it when you look at it, differential thrust, but it was fixed positive buoyancy, it had wings that needed forward thrust, and we built that as purely a proof of concept. The next thing we built was this two-seat flight trainer prototype. It's kind of gotten around a bit. And then from there, we built Challenger and I'll get onto this one. This was built for Steve Fossett, yes, that's the guy who just disappeared last September. He went. Deep Flight 1 actually proved to be very, very successful. We did one National Geographic programme, flew it with giant manta rays, exquisite underwater ballet, rolling and tumbling with a manta ray that had twice my wingspan. And if you ever see that documentary, it says that we couldn't keep up. That wasn't the problem. The problem was the animal ballet was so slow I was constantly stalling, it was hard to control. But a beautiful thing, and she just proved a point. That's actually a crew photograph amidside. But that manta ray came within 3" of my canopy, I'm not sure what it was up to. That's the prototype of a two-seater flight trainer. And now, we get into the certification issues. We built that out of class. The one before that was built out of class. Previously, 50 or 60 subs for Lloyds and ABS, ABS can't deal with composite pressure hulls, they certainly can't deal with positively buoyant submersibles, and they can't deal with the kind of centre of gravities. So to try and fit that into—this is where it comes to innovation—to try and fit that into the current class system is like trying to build a fixed wing aircraft to a set of rules for underwater ballooning. Some of them apply, some of them don't apply. Like, throw out your anchor is a bit hard in a fixed wing aircraft, it really doesn't need an anchor.

Now here's where this gets interesting. We decided to build that as an experimental craft. We had some partners in that we were going to use it for SLs, we didn't need anybody's permission to go fly in the ocean but we ended up decommissioning this and selling it as scrap. And I'm going to try and keep my voice very calm and flat, but if it comes across a little bit cynical, you're imagining it because I'm being perfectly *reasonable* and calm. The new owners of this took it to Monaco apparently and started a new company. They are now submarine builders. One is in real estate, the other's in software. I don't think they'd ever seen a submarine before. But now, they're submarine builders with this thing. Interesting story here. Tom Perkins, the owner of the *Maltese Falcon*, took one look at this apparently in Monaco, decided that this fixed-wing aircraft type thing would go well on his foredeck and decided he

wanted one. But Tom is a little bit different, perhaps, from many owners. He's just not that impatient and he's a venture capitalist, so he knows how to do due diligence, he started checking it, and goes 'wait a minute, these guys didn't build this, this outfit near San Francisco did', so we got a call from Tom Perkins, a little curious, a little cautious, a little bit suspect, 'can I come and see you?' 'Yes, sure'. Anyway. So there is that machine. It flies underwater, that canopy optically couples with water, it's just an exquisite experience. There is no question that this needs to be brought to the public. There's just no question that this is not going to be one of the most dynamic, powerful, blow your socks off, experiences that anyone's going to have. So it's going to come into the industry. The question is, this was uncertified, experimental. How do we do it? Why is it going to come in? Well, one reason is, animals just love this thing. I took a reporter down, was in the back seat, this was 15 feet off Monterey, I said you know, there's very little point in coming, the water's green, there aren't any animals there, this is the most boring place on earth. But he wanted to come anyway. We ended up flying through a cloud of jellies with the light just shimmering through the underside waves. It was just magical. And then, the guy in the back screamed, loud and hard. I mean, he just screamed. I broke my neck trying to turn around to see what had happened—and what happened was, this guy was plastered on the wingtip, a big sea lion decided this big blue thing was his new master and he was going to be the wing man so we had a sea lion just sitting right on that wing tip. And the guy behind was screaming. And then the real boss, one of these guys, came and just looped right around my canopy. It was just spectacular. So that's why this is all going to happen, because it's so spectacular. It cannot not happen.

But you want a private sub that goes deeper? Well, this was built for Steve Fossett. The guy who went around the world in a balloon, the guy who recently set records for high-altitude gliding, his records for a sailboat—you perhaps know Play Station—what was it called before Play Station—it's now called Cheyenne—yes, he's the guy who last September, silly man, flew off in a little light aeroplane into the Nevada desert and disappeared and yes, we're one of the guys that went up there and tried to find him and we couldn't. But that submarine was built, 37,000 feet, twice as deep as anything else. Built for a private individual. Not the average owner, somebody who really could have handled this and taken that down. There she is, and there's our crew that built it. Just a beautiful machine, sitting there. This is the Maltese Falcon—I went through that story, Tom Perkins came in—what do you have on the drawing board—I was about to design the ultimate sub for myself, it was called Super Falcon, it wasn't deep, it was just beautifully balanced. And Tom decided he wanted the first one, and this is it. We actually splashed it down in the water about two weeks ago. There's the website and there's an artist's impression. Now, the thing is... this is the safest sub I've ever built by far. It has a safety factor of 5:1 on the pressure hull, positively buoyant, can't get stuck, can't get trapped, it's just an exquisite machine and predecessor to this, a 50 – 60 I've forgotten how many, mainly ABS but certified craft, this is by far the safest one. ABS can't certify this. Why? Because they don't do composite pressure hulls. It made me feel like—you know if you go way, way back, there were times when all ships were wood, and then somebody started building them out of steel and there must have been times when there were forums like this and there must have been learned gentlemen standing up and saying 'well, you know, I think a steel ship will sink'. It makes me kind of feel that we're in that era. We do need innovation. We do need third party verification. We do have the challenge now of taking this back into the community. We can go back in through Lloyds, they certified about 50 composite hulls before, so that's not going to be a problem. One of the things I do want to make a plug for in terms—I think we do need different certification, I think it needs to switch to a performance base. Let me tell you why. The current rules and regulations for certification of submersibles are

based on old ship designs. I don't see that you can test a ship through a hurricane. So what you have to do is, you have to certify it—if this craft is built from certified materials that we know about, to this method that is known about, with these skills that we know we know about, then we can predict that this ship will probably survive a hurricane. There are other things that need to be tested. Gun barrels for one, historically. That doesn't work with gun barrels. With gun barrels, there's a much easier way. You want to see if that gun barrel is not going to explode in your face, you proof test it. You take that sucker and you pressurise it, 1.5 times is maximum operating stress, you prove it. A performance-based test. The reason we didn't have performance-based tests with submersibles back in the 50s was the safety factor was about 1.5. That was about where they were being built and operated. So if you designed back then a 3,000-foot submersible, it was planned to implode at about 4,500 feet. If you come back down now and somebody builds a 100-foot shallow submersible under regulations, in theory it can implode at 150 feet. I don't think that 50-foot margin really works. So I would propose that in parallel to the existing regulations, we really try, if we're going to do anything new, for goodness sake, let's go on a performance-based system. Let's say prove it. So what I said to Tom Perkins—'you want a 400-foot sub. I can't build you a 400-foot sub. I don't trust a hull that thin. I'll build you a 1,000-foot one and we'll call it 400 feet.' And that's what we shook hands on. So. We do need innovation, we do. We've got it. We can't go backwards. We're flying underwater. We cannot go backwards. We can't fit that in under ABS but you can under Lloyds, so maybe we're OK. But if there is any new regulation, if any of these groups start thinking about new stuff, for goodness sake, make it performance-based and not just a big, thick bible of if you follow these steps you're probably going to be allright. I understand why ABS will not deal with composites, there were just too many variables—

Tork

Graham, I'm really sorry. But I'm going to have to stop you because we're going to have to allow some time for questions and discussions. Thank you very much.

Firstly, do we have any direct questions as yet? OK. Let me put a point—we've got two clear ways of looking at it here. We have an existing certification and classification process and we also have Graham who would like to look at it in a goal based standard. Forgetting those two conflicts for the moment, you're trying to develop the management company's approach, if you like. The integration. But yet one of your subs, Will, is already on an ISM certified vessel—it's over 500 gross tons and it's in management. So, presumably, it is integrated within the ISM system. If it is, why do you need anything more than that?

Will

Well, it's a good question. The short answer is, it's up to the manufacturer to do it right. Are you doing it just for the money or are you doing it because you want to do it right, you've got a future out there you want to shoot for. The regulations—I mean just personally within our company—we follow regulations because we figure they're minimum standards we want to meet. But they're certainly not the maximum we put in. There's tons of safety factors we put in just for lots of variations in there. So—and it's a typical issue with all codes—I'm on several national committees on various codes, and it always comes back up and members of the committee remind everyone, look, those are the minimum requirements. They're just enough to be OK. It doesn't mean that's where you've got to stop. By the time—if we have the ISM,

we're meeting ISM because we're really going out and making sure we do everything we can to give us all the margins possible to meet it. It's not required.

Tork

What I'm getting at is, that the management company involved, which is one of the big 5, must have satisfied themselves that the operational procedures protect them as the DPA?

Will

Fair enough. Yes, they have. And that is the beauty of it. Some people say—you're nuts, trying to build submarines and just giving them to strangers to go and play. No, we're not nuts. We do know there are professional people out there that do that. But there are a lot of misconceptions out there. There are a lot of errors that go—there's a lot of myth that gets told and unfortunately—we had some of the discussions yesterday between brokers and setting expectations on owners. This is complicated stuff. I am amazed and truly encouraged to see the crowd here and it's so wonderful to sit in a group where we're almost sitting like all in a kitchen, that's how I see life. We're all in the kitchen, and the owners are sitting in the living room waiting for something. They don't care how you're making it. But we're all in the kitchen, we're just going to make it happen.

Tork

Richard, what's your view of the role of how it operates within ISM? Whether on a private, by the way, or on a charter vessel?

Richard

On this particular case, Will's customer happened to buy an excellent vehicle from an excellent highly experienced supplier. He got lucky. Will knew how to integrate the submersible onto the vessel, had a training programme. What we're concerned about are the submersible manufacturers who are offering a vehicle to an owner saying 'yes, we'll throw in 2 days' worth of training, here you go'.

Tork

But presumably that would not—I'm sorry to keep going back to ISM—but it does serve a very useful function. And presumably such a submersible would just not fit in. It wouldn't be acceptable, would it?

Richard

No. ISM doesn't tell you how to operate a submersible, it doesn't tell you what minimum training—

Tork

But it does demand that you find a way to do it, doesn't it?

Richard

No. The regulations make zero reference to how that submersible will be integrated technically or operationally on board a yacht. Right now, we're just hoping that the ethical standards of the owner, the operator and the manufacturers come together and create a safe operating environment for charter guests.

Tork

Presumably, in your management company, you wouldn't integrate one without doing it right?

Richard

Oh, we will, absolutely. But we don't want a Camper & Nicholsons standard. We want a yacht industry standard that Caymans can accept, the U.S. Coastguard, any flag or port state will accept.

Tork

But it could easily be developed, from the way it's already been handled, by a management company.

Richard

Yes, and that's what we're here for. Is to start that dialogue.

Sam Brown Knight & Carver

The question is whether or not you've considered a model in which you sell, instead of selling the submarine, you sell the service? And you provide a submarine, and you provide an operator, you provide a life-cycle support and maintenance programme and you provide it to the yacht then the risk mitigation for the owner is that you take that on, at least at the beginning, so you could do proof of concept, you get your submarine on the boat with one of your operators, with one of your maintenance programmes. Because I think, obviously, that if something goes wrong, there's going to be the issue of well, it's operator error, the maintenance programme wasn't done, you didn't even buy the spare parts you're supposed to have. All those other issues. I've seen it done in other industries. And it's a model that you may want to think about.

Will

That's a very good point, and that's exactly the model we're following. It works. It does take some time, and usually the biggest issue is agreement up front when you're getting into this, that you plan this at the outset—This is how it's going to happen, that's when we finish, that's when we come on board, that's when we install it, we integrate, this is how long the training will take, this is how many people you need to have. And we will be there holding your hand along the way. There's cost associated with it. It works. The issue is—someone can't come and say you know what? These machines are so complicated, ours are so simple, after a day anybody can drive this. And if everybody signs up to it, in the absence of knowledge, and all agreeing to it, you have the potential for a problem, because there's nobody checking on that.

Graham

I'm not sure what the answer is, really I'm just torn between the two. I could argue either case. I could argue that we should be scared to sell a submersible to a private individual. But you know, if you look at the early days of aviation, light submarines are less scary than light aircraft. And so, if you put our panel controlling light aircraft, that would never happen. And I do look at that, having learned to fly light aeroplanes. I don't know how an instructor could ever let me loose with it. But they did and people kind of survived. So I'm torn. We're trying to find the answers. And one of the obvious things is, we can teach somebody to fly one of our craft in we think 3 days, competently. But that's to competently master the craft. That would be the same as—drive the car and turn corners and stop and brake. That doesn't mean, if you let somebody loose in traffic, they're not going to do something stupid. So how the heck do we certify somebody to go underwater if they fly the thing into a wreck and jam the thing in there, it's a big problem. I don't know the answer.

Tork

I've just got another question here from the floor. I'll come to you in a minute, John. Go ahead please?

[From the floor]

I wonder if the analogy of the helicopter is with exploring—from the point of view of—the experiences I've had with boats that have got submarines—U.S. Navy submarines sitting on the foredeck was that the helicopter pilot also became the submarine pilot. And I wonder if there's some cross credit with regard to helicopter skills when it's going up and down, and the second comment really is that, as soon as the submarine was down, the first thing the owner wanted to do was speed it up so he could chase the sting ray. And so, with regard to expectation, it's very nice to go down and explore this wonderful environment, but these guys in my experience anyway want some action and they want to go forward and follow these things pretty quickly. So I don't think it's a big step between the helicopter type style and the glider style becoming the standard.

Tork

Right. John, I know you wanted to make a regulator's point?

John Aune Cayman Islands Shipping Registry

I just wanted to comment a bit on what was said earlier today, during the presentations, and during the first comments here, now, as well, that there are no regulations really for the operation of the submersible. And that's not entirely correct. I mean, I'm a senior surveyor with the Cayman Islands Shipping Registry and in the Cayman Islands, we've had regulations for one-atmospheric submersibles since the 1990s. In 1991, we implemented our regulations for submersibles. We saw the need for having these regulations because there were tourist submersibles that wanted to operate in Cayman waters. However, the last few years, we've actually seen yachts registered in Cayman Islands buying submersibles to put them on board the yachts and operate them from the yachts, some privately and some also wanting to use them for commercial operation. So we have regulations, both for the design, construction and equipment side of it but also for the operational part of it. In addition to that, you also have the IMO, the International Maritime Organisation, that published in 2001 the guidelines for the design, construction, and operation of a passenger submersible craft, that we sometimes use as well when we certify

submersibles going on the yachts. And the Cayman Islands, like I mentioned, have two different sets. One for construction, one for the operation. The operational regulations do specify some parts of it. It places responsibility, says what the responsibility is for the owner, what the responsibility is for the operation controller, for the pilot, gives the chain of command, speaks about the training of the pilots, and it also tells you that you need to have written procedures for certain items. And it doesn't give the specifics of what needs to be in those written procedures. And that's where something like what was discussed here earlier would be good. That you had a best industry practice, basically, that could be a guideline for the management companies, the submersible operators in what they would need to address in those procedures, what would actually need to be there to meet the procedures. And as you talked about earlier as well, Tork, you've got the ISM system on board already and isn't that sufficient? Well, not really. You need to have this on the side of it, but you make it part of your ISM systems. You need to have somewhere where it specifies what you need to have procedures on. But when you have it, you implement it and you make it part of the ISM safety management system on board.

Tork

I think—unfortunately, we're running very much out of time—but the impression I'm getting is that where we are at the moment is that we have essentially existing standards for the construction, we have existing requirements at least from CISR for broad operational guidance. What you're hoping to do now is to move forward and create more specific industry standards or guidelines, best practice, which is something that obviously we need the industry out there to participate in, and we're very happy to create a forum for doing that, if that's of any help to you? Because we obviously need some way to gather the information. However, it's also true that if nobody innovated, nothing would happen. So perhaps the next stage is to look at the possibility of goal-based standards, which are after all relatively popular as a buzzword with both IMO and class. John, do you see the possibility of using goal-based, or test-based, standards, maybe not today but in the future, for submarines such as Graham's?

John

Certainly. I think you were talking about it earlier as well, and I think that most of the class societies are interested in doing that as well. It takes them a lot of time to do it, it's not something you can do overnight, basically, but if you sit down with the class societies and discuss it, they will definitely be willing to do it. I mean if not, we wouldn't have seen composite yachts, the size we have today, either. If you go 15 or 20 years back, they wouldn't allow you to build that, would prohibit it structurally anyway. So if you sit down with the class societies and discuss alternative arrangements, novel designs, I think you'll find that people are willing to listen to you and willing to accept equivalent arrangements, if you just reach the same level of safety, basically.

Tork

So, in effect, there's a twin pronged approach. You have the pragmatic let's get away to have yachts—a pragmatic way to get it going for now, and also a longer term way to allow innovation within the industry.

Bill Zinser Yacht Logistics Inc

What's the insurance companies' viewpoint on all this? Wouldn't they be dictating, or requesting certain guidelines in order to insure?

Tork

Do we have an insurer in the house?

[From the floor]

They do. But then you get a whole range of different customers. Someone who's going to go through a large yacht management company and has got a large yacht and so forth, they have the umbrella for it, but then we have clients that just say, 'oh, I paid for my boat, I paid for the submarine, I don't need either of them'.

Tork

Just another point. I mean you're focussing on the charter market. Cayman Islands require certification of a submarine no matter what, private or otherwise. However, the analogy of a helicopter is a little different, because in a helicopter you can actually make a complete idiot of yourself as long as you're in private operation. I'm not saying that's a good thing. But here—Richard you were speaking extensively about the charter market. But surely, logically, if Cayman already apply this to every vessel, this is actually not a charter standard at all, it's actually a standard, full stop.

Richard

But as a yacht manager, if we apply the highest standard to the charter, which I believe we should, I think charter guests, passengers, deserve the highest possible standard, just like walking on board an airliner, they have a right to assume they're walking on board an absolutely safe operation that meets every standard. Right now, insurance isn't much of a problem because they have no loss history. We're trying to make sure that that stays that way, that there isn't a loss history, and we have a guideline. Ultimately, my guideline is the creation of a document that can be applied to charter or privately operated yachts that's acceptable to the regulators and to the insurers, and provides a baseline for a safe operation.

Tork

Sure. Unfortunately, it's a final comment because we have run out of time—

[From the floor]

To answer Bill Zinser's question on the insurance, what is their role in this whole thing? Yes, they do get involved. What is missing on that submersible we just installed on a superyacht, the insurance company first required a class, they wanted to know if it's classed or what standards are done, they did—once we did the installation on the yacht—integrating the ISM system—well, nobody had quite thought about it and then we found ourselves as the manufacturer trying to find how to fit it all in the yacht, what should the ISM be. The underwriter then says 'well, you know what is the operation?' I mean, I know it's class, I know the vessel is built OK, how is it going to be operated? And we had to create it with the captains and the yacht management company to do it. Now, we did it on a best effort basis, with the management company, but it doesn't make it a standard, that's just what we did for this yacht. And we had to problem solve, to answer the underwriter 'OK, how exactly

is the whole picture going to work?' And we came back, and that's when Rick came and looked in and said 'we've solved that problem for that yacht, we're pretty knowledgeable, we have the experience to do it', it's a good management company maintaining it, so we came up with a solution, but that doesn't make a standard. And the question from the submarine industry—whether they're classed or unclassed, or which flag state, is not really the issue. It's then well, we found ourselves doing this, for that yacht, sorted the problem out, but then for industry-wise, it's not a standard, it's not something the submarine guys can do on their own, because a lot of stuff on they yacht side I didn't know. We figured it out, and I think the dialogue, which we hoped everybody would be willing to participate, is to not depend on individual manufacturers or independent yacht management companies, to make their own standard out of it. Problem was solved, but it doesn't set the tone. And some other issues that came up? Will the captain be allowed to dive the submarine? Well, if he leaves the ship, it doesn't really make sense, does it. So you find yourself problem solving that situation for the industry, because it is pulled from the owners, there are more owners going to be requesting that, and I think that problem solving is done in this room.

Tork

OK, thank you. One very brief final comment from John.

John

I just want to comment on—I mean the projects we've been working on we've had fairly big yachts, 120 plus metres, we had an 8-passenger, 2-pilot crew on board, etc. And we do look at that. We've got smaller yachts as well, with 1 passenger, 1 pilot, sub on the 160-foot yacht as well. But we do look at that, and we do review the operations manual, we do look at the training, we do look at who's going to operate it, we do look at all of that, review the manual, and then we go on board and see that they're actually operating it in accordance with what they said that they're supposed to do.

Tork

But John, I'm presuming that CISR will be involved in this technical committee?

John

Possibly, yes. If we're invited—

Tork

You appear to have the lion's share of the submersible market as well as the sailing one, so I mean—

Thank you very much, gentlemen—and I look forward to learning more about this at GSF and, please, participate everyone. Thank you.
