Future Thinking S2 E3: Getting the world's first ammonia fuelled vessel on the water

00:00:06.958 --> 00:00:13.978
<v SPEAKER_1>Hello, and welcome to Future Thinking, an Alongside mini-series from North Standard, one of the world's leading marine insurers.

00:00:15.038 --> 00:00:22.878
<v SPEAKER_1>I'm Helen Barden, and in this mini-series, we will, with the help of my guests, navigate our way through some of the elements of maritime decarbonization.

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<v SPEAKER_1>In today's episode, which is the third in the mini-series, I'm joined by Ros Blazejczyk, managing partner at Solis Marine.

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<v SPEAKER_1>Thanks very much for joining me today, Ros.

00:00:34.558 --> 00:00:35.778
<v SPEAKER_2>Hi, Helen, yeah, no problem.

00:00:36.378 --> 00:00:45.158
<v SPEAKER_1>Perhaps if we could start, Ros, by you giving us a bit of your background and an introduction to Solis Marine and the work you do there.

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<v SPEAKER_2>Yeah, of course.

00:00:47.018 --> 00:00:50.778
<v SPEAKER_2>So I'm the managing partner and actually one of the co-founders at Solis Marine.

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<v SPEAKER_2>I'm a naval architect, and my background is primarily in salvage and wreck removal, as well as offshore design engineering.

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<v SPEAKER_2>I studied at the University of Southampton.

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<v SPEAKER_2>I graduated in 2006 and then joined a company called London Offshore Consultants.

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<v SPEAKER_2>And then in 2012, I left LAC, and that's when we set up Solis Marine.

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<v SPEAKER_2>So Solis was set up, the focus on shipping incident investigation, salvage and wreck removal.

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<v SPEAKER_2>But since then, we've diversified, so we're really a full service marine consultancy now, providing expert technical services to ship owners, insurers, lawyers and government agencies worldwide.

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<v SPEAKER_2>And then in 2018, we set up our engineering division, and through there, we provide naval architecture and design engineering on a wide range of projects in clean shipping, marine renewables and offshore projects.

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<v SPEAKER_2>So our team consists of master mariners, marine engineers, naval architects, design engineers, and structural engineers, and we've got offices across the UK, Singapore and China.

00:01:50.978 --> 00:01:52.078
<v SPEAKER_1>Great, thank you, Roz.

00:01:52.558 --> 00:02:00.778
<v SPEAKER_1>Now, ammonia has very much been marked as one of the key future fuels for shipping as we move away from fossil fuels.

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<v SPEAKER_1>And my understanding is that you've been developing designs in relation to retrofitting ships with engines capable of burning ammonia.

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<v SPEAKER_1>And I just wondered if you could tell us a bit more about that.

00:02:14.058 --> 00:02:14.658
<v SPEAKER_2>Yeah, of course.

00:02:14.678 --> 00:02:23.258
<v SPEAKER_2>So we've been involved in a couple of projects with vessels running on ammonia as a fuel, those sort of being refit options as well as new build options.

00:02:23.578 --> 00:02:31.278
<v SPEAKER_2>So recently we provided design engineering services for the Fortescue Green Pioneer, and that was a PSV converted to run on ammonia.

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<v SPEAKER_2>This was the full world's first use of ammonia as a marine fuel, and they've just completed the sea trials for that here in Singapore earlier this year.

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<v SPEAKER_2>Our role in that was to provide naval architecture and design engineering relating to the integration of Fortescue's ammonia fuel technology onto the existing vessel.

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<v SPEAKER_2>So this started with the concept design for the fuel ready stage, and that was in terms of the deck layout, so where the ammonia tank would go, the tank connection space, fuel preparation room, bunker station arrangements and so on.

00:03:01.058 --> 00:03:03.318
<v SPEAKER_2>And then we continued through to the detailed design.

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<v SPEAKER_2>So that was relating to aspects like the fuel tank foundation, vent mast, like ventilation and fire systems, and vessel structural modifications amongst others.

00:03:14.278 --> 00:03:24.538
<v SPEAKER_2>So that's probably our most recent involvement with ammonia fuel vessels, and it's nice to see that as the world's first really on the water now and operating on ammonia is good.

00:03:25.178 --> 00:03:32.058
<v SPEAKER_1>Yeah, I mean, it's obviously very exciting to be kind of right at the cutting edge, I suppose, as you have been.

00:03:32.958 --> 00:03:37.338
<v SPEAKER_1>And you've obviously been dealing with not just the retrofits, but also new build.

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<v SPEAKER_1>And I just wonder what are the key differences in terms of the challenges between looking at ammonia-fuelled ships from a new build perspective and also from a retrofitting perspective?

00:03:51.318 --> 00:03:54.018
<v SPEAKER_1>What are the different challenges that you face with the two?

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<v SPEAKER_2>Yeah, I think there's general challenges in terms of retrofits with any kind of fuel technology that you might be looking at.

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<v SPEAKER_2>And that really stems from adapting a vessel that's not designed for a particular technology and then working within the constraints of that original design to put a new system in.

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<v SPEAKER_2>So as an example, we recently worked on a project to convert a survey vessel to run entirely on a hydrogen fuel system.

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<v SPEAKER_2>And the idea was to entirely replace the existing diesel system with a hydrogen fuel cells driving electric motors.

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<v SPEAKER_2>So complete replacement of the system.

00:04:31.938 --> 00:04:45.378
<v SPEAKER_2>So as with any project, we started with a review of the way the vessel operates, and looking at its duty cycle, then looking at how we can potentially reduce the required range of the vessel, because then you can reduce your fuel storage requirements.

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<v SPEAKER_2>We went through all that process, and eventually, whilst it was still feasible, the amount of storage that was required, the hydrogen storage was so huge that it really restrained the design.

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<v SPEAKER_2>And in the end, it was not really a practical way of going forward.

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<v SPEAKER_2>So in that sense, the refit option, going to a fully hydrogen system was just not a sensible way forward.

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<v SPEAKER_2>But what that project is now doing is looking at a hybrid system for the same vessel.

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<v SPEAKER_2>So what that's going to do is actually still going to be using hydrogen with fuel cells, but actually put that drivetrain in parallel with the existing diesel drivetrain.

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<v SPEAKER_2>So then the vessel's got the option of working in zero emissions mode.

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<v SPEAKER_2>But then if there are issues with, say, fuel supply, if they're not able to bunker hydrogen, then they can operate on diesel as well.

00:05:37.478 --> 00:05:43.058
<v SPEAKER_2>So I think the thing you've got to bear in mind is that with any of these vessels, they've obviously got contractual requirements as well.

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<v SPEAKER_2>They've got to be able to meet the obligations that they have to their customers, if you like.

00:05:48.558 --> 00:05:58.618
<v SPEAKER_2>So it's all very well saying that a vessel can operate on zero emissions mode all the time, but if for some reason there's no hydrogen available, then they've got to be able to still do their job.

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<v SPEAKER_2>So I think that highlights some of the issues.

00:06:00.838 --> 00:06:08.418
<v SPEAKER_2>Just filling in a new technology into an existing vessel that wouldn't have been designed to have those types of solutions on board.

00:06:08.698 --> 00:06:24.298
<v SPEAKER_1>Yeah, and I think you also, they're touching upon the, it's not just the ship, but it's also the trading pattern of the ship as well when it comes to the retrofit and the fact that you say, you know, there's the customer's requirements that need to be borne in mind.

00:06:24.318 --> 00:06:41.598
<v SPEAKER_1>And actually, if the production and ability to bunker at certain places is not available, then that obviously causes problems when it comes to looking at what are the feasible solutions to retrofit the ships.

00:06:42.698 --> 00:06:53.498
<v SPEAKER_1>And you also briefly mentioned the kind of tank capacity and the fact that using these fuels means that more space is taken up by the fuels.

00:06:53.798 --> 00:07:07.218
<v SPEAKER_1>And I just wondered if you could elaborate on that a little bit in terms of, you know, when you're looking at ammonia or hydrogen, how much more space are you talking about as compared to traditional fossil fuels?

00:07:08.518 --> 00:07:18.558
<v SPEAKER_2>Yeah, so if we're talking about the energy density or the volumetric energy density, then you need an awful lot more space, particularly with hydrogen.

00:07:18.578 --> 00:07:24.078
<v SPEAKER_2>I think it's five times more space or more volume that you'd need compared with fossil fuels.

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<v SPEAKER_2>And ammonia itself is two or two and a half times.

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<v SPEAKER_2>So that's the real issue with hydrogen at the moment for deep sea shipping is that you just can't get the range without needing huge amounts of fuel storage, space on board the vessel.

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<v SPEAKER_2>And then of course, if you filled the vessel up with fuel tanks and there's not enough space to take cargo, then there's not much point really.

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<v SPEAKER_2>So that's really why ammonia is certainly coming to the fore as the key solution for deep sea shipping in terms of a zero carbon option.

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<v SPEAKER_2>Methanol is up there as well, but obviously that still contains carbon.

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<v SPEAKER_2>But that's really one of the key drivers, because if you look at alternative fuels and propulsion, really the starting point is a fully electric solution, because electric motors are so much more efficient than internal combustion engines.

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<v SPEAKER_2>I think it's about 85% efficiency in terms of using the energy and converting that into the forward motion in the vessel.

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<v SPEAKER_2>So that's really the starting point, but you've got to have storage for fully electric, of course, and batteries are heavy.

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<v SPEAKER_2>So battery and fully electric solutions only really work for vessels operating with a range of really around a day or so.

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<v SPEAKER_2>So it's great for short haul ferries, maybe, fishing vessels, leisure craft.

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<v SPEAKER_2>But then as your requirements get longer, then we have to start looking at other options.

00:08:49.218 --> 00:08:57.458
<v SPEAKER_2>That's when hydrogen fuel cells come in, and that might extend your range through to a few days or maybe a week with a hybrid system.

00:08:57.878 --> 00:09:12.618
<v SPEAKER_2>But once we get into deep sea shipping, then that's when we're starting to look at ammonia and also methanol as a solutions there, because otherwise you just don't have the energy density with the likes of hydrogen or for the electric solutions.

00:09:12.638 --> 00:09:19.438
<v SPEAKER_2>So there's definitely no one sort of single silver bullet, if you like, to the decarbonisation problem.

00:09:19.758 --> 00:09:23.978
<v SPEAKER_2>It's all driven by that operating profile of the vessel that you mentioned.

00:09:24.438 --> 00:09:27.098
<v SPEAKER_2>So when we approach this project, that's always the starting point.

00:09:27.118 --> 00:09:29.858
<v SPEAKER_2>It's like, right, let's look at the way the vessel operates.

00:09:30.438 --> 00:09:37.158
<v SPEAKER_2>As you say, look at what fuels are going to be available, potentially, what the range requirements are, and so on.

00:09:37.738 --> 00:09:44.278
<v SPEAKER_2>And then that's your starting point to then drive your decision process in terms of the technology solutions.

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<v SPEAKER_2>And I think that's one, in that sense, the hybrid approach works quite nicely, perhaps on the smaller ship side of things, because you also want to keep some flexibility in the designs as well.

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<v SPEAKER_2>And I think one of the key issues for ship owners at the moment is they don't know what fuels are going to be available necessarily down the line.

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<v SPEAKER_2>So quite a lot of our projects look at hybrid approaches where we might have electric motors fitted, but then that electric drive chain can be fueled by either hydrogen fuel cells or eventually potentially ammonia fuel cells, or even just existing fossil fuels.

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<v SPEAKER_2>Because actually, even if you're using diesel to drive an electric motor, it's still more efficient than using diesel directly into an internal combustion engine.

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<v SPEAKER_2>So if you look at those kind of modular approaches, then you can kind of future proof designs a little bit for the future, so that you can integrate different technologies as things develop.

00:10:43.398 --> 00:10:46.678
<v SPEAKER_2>So yeah, that's one of the approaches that works quite well.

00:10:46.798 --> 00:10:54.958
<v SPEAKER_2>Kind of, yeah, again, for vessels at the smaller end of the range, not so much for deep sea vessels operating with more constant speed, shall we say.

00:10:55.498 --> 00:11:00.238
<v SPEAKER_1>Yeah, I think that's a really key point in this energy transition.

00:11:00.258 --> 00:11:03.138
<v SPEAKER_1>Like you say, there's not going to be one silver bullet.

00:11:03.158 --> 00:11:06.138
<v SPEAKER_1>We're looking at a range of solutions.

00:11:06.398 --> 00:11:14.758
<v SPEAKER_1>And at the moment, it's kind of unclear because of the fact that the infrastructure for all of these fuels isn't in place.

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<v SPEAKER_1>The regulations aren't fully in place either, that it's difficult for ship owners at the moment to decide which way to go.

00:11:26.718 --> 00:11:35.478
<v SPEAKER_1>So I think it's interesting to hear that there are kind of options to potentially try and future proof things a bit.

00:11:36.638 --> 00:11:45.598
<v SPEAKER_1>And just wonder if we go back to ammonia briefly and looking at some of the issues around the use of ammonia.

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<v SPEAKER_1>We obviously know that in terms of ammonia, it's highly toxic, it's flammable, it's corrosive.

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<v SPEAKER_1>And I just wondered from a design perspective, what elements get taken into account to deal with these kind of risk and safety aspects for the crew?

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<v SPEAKER_1>I suspect some of that comes with the operational side as well, but from the design side, what particular things do you have to bear in mind and what gets addressed in the design itself?

00:12:17.518 --> 00:12:24.258
<v SPEAKER_2>Yeah, so the safety considerations really design, they drive the design right from the start, actually.

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<v SPEAKER_2>So even from right in the beginning, when you're looking at the layout on the vessel, so where your fuel tank is going to go, where's the balance of equipment going to be, that's all already driven by safety requirements.

00:12:36.658 --> 00:12:52.838
<v SPEAKER_2>So in that sense, you need to have a layout and you need to have safety zones, you'll have toxic zones, for example, defined so that you can't, in the event of a release of ammonia, you can't have ammonia going into a manned space within the vessel.

00:12:52.858 --> 00:13:00.818
<v SPEAKER_2>So these are quite well-defined regulations in the codes and standards that drive that initial concept design.

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<v SPEAKER_2>So it starts at that stage, and then moving forward into, as we get slightly more detailed, you have to have secondary enclosures around any piping, any equipment, or any space that might contain ammonia at any time.

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<v SPEAKER_2>So the secondary enclosure is like your first line of defense.

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<v SPEAKER_2>Within those, you then have to have automated detection.

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<v SPEAKER_2>So in case there is a leak of any kind, that has to be isolated, and the system is shut down automatically.

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<v SPEAKER_2>So that has to happen without requiring human intervention, if you like.

00:13:33.058 --> 00:13:36.278
<v SPEAKER_2>They then have to be fitted with ventilation systems.

00:13:36.278 --> 00:13:43.398
<v SPEAKER_2>So any spaces that personnel might be in have to be designed to safely contain any release of ammonia.

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<v SPEAKER_2>So that means they'll have normal ventilation ongoing all the time, and then they'll have a catastrophe ventilation system that can be started as well in case of a release.

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<v SPEAKER_2>And then for both of those systems, you have a primary and a secondary system as well.

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<v SPEAKER_2>So you have full redundancy.

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<v SPEAKER_2>So it just means that no one failure can cause an issue with all of those systems.

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<v SPEAKER_2>So you have layers of redundancy built into the system really to make sure that all of those safety issues are addressed right from the start.

00:14:15.178 --> 00:14:17.698
<v SPEAKER_2>And then all the way through to the detailed design as well.

00:14:18.318 --> 00:14:28.858
<v SPEAKER_1>And then following on from that, I suppose there's the training aspect and the operational aspect that then gets dealt with from the safety side for the crew.

00:14:30.558 --> 00:15:03.298
<v SPEAKER_1>Something that we talked about with a previous guest, James Vorsteig from the Maritime Decarbonisation Hub, he was talking about human-centric design as opposed to system-led design in the future to try and reduce, I guess, safety risks and to not have to necessarily fill the safety gap with training in the same way that we do now if things are kind of looked at from the human-centric design from the start.

00:15:03.658 --> 00:15:22.538
<v SPEAKER_1>I just wonder as a naval architect, this is probably a broader question than just ammonia design ships, but what's your take on the need to perhaps look at ship design from a human-centric perspective rather than a system-led perspective generally?

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<v SPEAKER_2>Yeah, I think it's something that's becoming more and more important.

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<v SPEAKER_2>I think safety-led design is definitely prevalent across all of the work that we do, actually.

00:15:33.518 --> 00:15:39.178
<v SPEAKER_2>On the alternative fuel side of things, there are risks with ammonia, there are risks with hydrogen, with any gases, really.

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<v SPEAKER_2>So they all have to be addressed right from the start.

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<v SPEAKER_2>And I think in that sense, though, we're probably more guided ourselves by the rules and the regulations provided by the class society and the flag states.

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<v SPEAKER_2>And that's kind of one of the challenges as well, because they're changing all the time, and we're seeing those regulations changing even during the course of a project.

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<v SPEAKER_2>So we might start a project with one set of rules, and then by the end of the project, the rules have changed.

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<v SPEAKER_2>And I just found out yesterday that one set of rules that we were using for one of our projects has changed again, and that would have almost entirely changed the vessel design that we'd done for that particular project.

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<v SPEAKER_2>So yeah, I think for us, we're probably more guided by the rules and regulations and, yeah, sort of challenged by the changing landscape on that side of things.

00:16:28.158 --> 00:16:29.638
<v SPEAKER_2>And then there's Flag State as well.

00:16:29.658 --> 00:16:34.218
<v SPEAKER_2>So different Flag States have different levels of engagement over in Singapore.

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<v SPEAKER_2>Obviously Singapore are very active in leaving the ammonia, bunkering sort of landscape forward.

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<v SPEAKER_2>We've got projects in other parts of the world where the Flag State's less engaged, shall we say, more from a lack of resources than anything else.

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<v SPEAKER_2>They're just not able to commit resources to really engage with projects.

00:16:51.858 --> 00:16:55.538
<v SPEAKER_2>So yeah, I think that's our sort of experience of it, if you like.

00:16:55.578 --> 00:16:58.418
<v SPEAKER_2>I think the safety critical aspects are there.

00:16:58.918 --> 00:17:07.278
<v SPEAKER_2>They're incorporated in the design from the very beginning, but for us, we have to be guided by the regulations as they are and as they evolve.

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<v SPEAKER_1>That's interesting.

00:17:09.018 --> 00:17:27.118

<v SPEAKER_1>I mean, the fact that you have to be quite fluid when it comes to working on the design and changes throughout the process in terms of change and regulation, and I suppose that can also mean that cost increases when you're having to make these changes as the process goes on.

00:17:27.678 --> 00:17:43.658
<v SPEAKER_1>And just touching upon that side of things in relation to the cost, how prohibitive do you think at the moment cost is when it comes to retrofitting ships for the likes of ammonia or hydrogen?

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<v SPEAKER_1>Do you think that's something that at the moment is a barrier to a lot of the industry?

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<v SPEAKER_1>Do you see that changing in the future?

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<v SPEAKER_2>Yeah, it's a really interesting point because having just a few minutes ago said how wonderful electric motors are and how efficient they are and all the rest of it.

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<v SPEAKER_2>But actually, if you look at fuel cells, they're really expensive.

00:18:03.818 --> 00:18:15.098
<v SPEAKER_2>So the project on the survey vessel that we were doing, the costing for the fuel cells, it would have cost, I think, 1.5 million pounds or something for the fuel cells required for that project.

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<v SPEAKER_2>For example, a 60 kilowatt fuel cell costs about 50,000 pounds.

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<v SPEAKER_2>And compare that with your sort of average 50 horsepower outboard engine that you might have on your sort of little pleasure boat.

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<v SPEAKER_2>There's no way you're paying 50,000 pounds for that.

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<v SPEAKER_2>So there are definite issues at that end of the market.

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<v SPEAKER_2>But that's where actually ammonia and the internal combustion engine comes to the fore, because internal combustion engines are obviously very well established technology.

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<v SPEAKER_2>There's a completely developed supply chain in terms of manufacturers, spares, maintenance and all the rest of it have been around for a long time.

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<v SPEAKER_2>So that's where if those engines can be adapted to run on ammonia or other gas fuels, then there's a real benefit there in terms of the cost aspect, but also the sort of training and the maintenance and so on.

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<v SPEAKER_2>And it's been done before.

00:19:08.238 --> 00:19:16.178
<v SPEAKER_2>Back in World War II, there was a fleet of 100 buses in Belgium that got converted to run on ammonia because they had a fuel shortage during the war.

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<v SPEAKER_2>So they had all these buses going around with great big bags on top of them with ammonia inside them.

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<v SPEAKER_2>I'm not sure how safe it was, and it probably wouldn't be allowed these days, but it's not really completely new technology.

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<v SPEAKER_2>We've also got ammonia on the International Space Station, so they have about 400 kilos of ammonia up there as a coolant.

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<v SPEAKER_2>So, you know, it can be handled safely in high-risk environments.

00:19:41.358 --> 00:19:58.038
<v SPEAKER_2>So I think from that perspective, that's probably why we're seeing ammonia and methanol becoming the, you know, coming to the fore, should we say, in terms of solutions for deep sea shipping, because although the fuel is new, the technology itself is not necessarily that new.

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<v SPEAKER_2>So I think that probably will see a more cost-effective approach compared to the smaller vessels, which have, can potentially make greater efficiency savings, but are dealing with cost issues for sure.

00:20:11.918 --> 00:20:13.178
<v SPEAKER_1>That's really interesting.

00:20:13.178 --> 00:20:33.798
<v SPEAKER_1>I mean, do you think the retrofitting of ships, as opposed to, you know, we have obviously a lot of ships in the water now that still have a lot of life left in them, it's not the case of, you know, scrapping all the ships and building new ships with use of these new fuels.

00:20:34.458 --> 00:20:47.058
<v SPEAKER_1>How vital do you think it is to engage in the retrofitting of ships in order to meet the greenhouse gas strategy from the IMO to reach net zero around 2050?

00:20:47.418 --> 00:20:59.278
<v SPEAKER_2>Yeah, I think I'm probably straying into the area of the economists and so on, but my understanding is I think that for ships up to 10 years old or so, then it's a viable solution.

00:21:00.158 --> 00:21:07.058
<v SPEAKER_2>We actually did a study to compare the carbon emissions from a new build compared with retrofitting.

00:21:07.378 --> 00:21:14.298
<v SPEAKER_2>We had a client with a fleet of vessels in the Middle East who wanted to look at whether they should retrofit them or go for new builds.

00:21:15.138 --> 00:21:41.678
<v SPEAKER_2>And it really varies, but we found that depending on the processes used in terms of the raw materials, so if you've got your iron ore coming out of the ground in Australia, being shipped to China, then being processed there into steel and so on, the emissions from that process compared with the emissions from the retrofitting process, we found that that new build needs between three and six years to start making a net gain.

00:21:41.958 --> 00:21:50.658
<v SPEAKER_1>Yeah, I mean, I think it's really interesting that you kind of mentioned the new build side and the emissions impact from that as well.

00:21:50.838 --> 00:21:56.158
<v SPEAKER_1>And then, you know, you kind of look at the end of life emissions as well for ships.

00:21:56.178 --> 00:21:58.958
<v SPEAKER_1>So it's looking at the full picture.

00:21:59.718 --> 00:22:16.838
<v SPEAKER_1>And like you say, it's viable for ships perhaps of a certain age, but for older ships, it's perhaps focusing on the modifications in terms of operational and energy efficiency technologies that are more easily modified.

00:22:17.398 --> 00:22:31.678
<v SPEAKER_1>So I just want to say thanks very much, Ros, for your time today and for taking part in the show and for your fascinating insight into getting ammonia-fuelled ships or ships using other alternative fuels on the water.

00:22:31.698 --> 00:22:32.698
<v SPEAKER_2>No problem.

00:22:32.718 --> 00:22:33.638
<v SPEAKER_2>Thanks very much for having me.

00:22:34.158 --> 00:22:35.878
<v SPEAKER_1>And that's all for today's episode.

00:22:35.998 --> 00:22:46.218
<v SPEAKER_1>Remember to listen to other episodes in this mini-series where we will look at the challenges and opportunities for shipping in this energy transition, as well as looking at sustainability through a wider lens.

00:22:46.918 --> 00:22:53.918

<v SPEAKER_1>In the next episode, I'll be speaking to Michele Bow, Chair and CEO of Core Power about bringing nuclear to commercial shipping.

00:22:54.298 --> 00:23:02.278
<v SPEAKER_1>You'll find the Alongside podcast and this mini-series on the North Standard website at northstandard.com or wherever you get your podcasts.

00:23:02.658 --> 00:23:05.558
<v SPEAKER_1>You can also click follow to ensure you don't miss an episode.

00:23:05.978 --> 00:23:09.258
<v SPEAKER_1>So from me, Helen Barden, thank you for listening and bye for now.