

Presentation to delegates of the IMO

Realizing Net Zero with Nuclear Power

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IMO MSC108 - 20th May 2024



New nuclear at the IMO:

Why shipping needs nuclear energy

Mikal Bøe

Chair - Working Group 6

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Ladies and gentlemen, honoured delegates, friends, and colleagues.

My name is Mikal Boe, - I serve as Chair of the Maritime Applications and Nuclear Propulsion working group at the World Nuclear Transport Institute, and as Chairman and CEO of CORE POWER – based here in London.

Today is a sense of occasion for me.

It is the third time that I address the delegates of the IMO on the topic of new nuclear for maritime.
(I hope that I will be third time lucky when speaking with you today.)

Ladies and gentlemen - We now stand at the brink of a new era.

That is one - that must see us BOTH meaningfully reduce and eventually eliminate GHG from shipping - and improve our energy efficiency.

If we do not – we will end up polluting MORE, not less. And that is not why we are here.

These two challenges present an almost unsurmountable issue of scale. But they also present us as an industry - with an opportunity of a lifetime.

The opportunity to demonstrate worldwide, how the ingenuity of ocean transportation, built over millennia, in the face of adversity and against all odds, that we can show the world, how this is done.

We have many options available, but only one option comes with true ZERO emissions. And only one - meaningfully improves our energy efficiency.

That, ladies, and gentlemen, is nuclear energy.

Slide 1. – Levelling the playing field



Levelling the playing field

Why?	Eliminate GHG from shipping, <u>and</u> improve energy efficiency.
What?	Nuclear is our <u>ONLY true ZERO emission energy source</u> – and we know it works at sea.
How?	Evaluate each alternative fuel and technology without prejudice, and without favour. Create a <u>level playing field for all fuels and technologies</u> .
Who?	IMO <u>must commence work</u> to revise SOLAS Ch 8, 'Code of Safety for Nuclear Merchant Ships' (Res A.491.Xii).
When?	MSC108 / 109 and onwards.

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One of the IMO's most important and enduring principles, is No favourable treatment - all ships, regardless of flag, should be bound by the same high standards – ensuring a level playing field for all.

That same principle must apply when we assess how to reduce GHG emissions – evaluating each alternative fuel and technology without prejudice, and without favour.

A level playing field must exist when we compare the relative merits of bunker fuel, natural gas, ammonia, nuclear, methanol, carbon capture, batteries, wind, and the rest.

Then we will see how we can realise net zero with nuclear power.

The title of my talk today.

Nuclear has an immense energy content (up to 4 mill x more than that of ammonia and methanol), - an incredible safety track record at sea, and produces only tiny amounts of waste - which is in fact the only waste from energy we manage properly.

- Nuclear is the ONLY - true zero emission energy - which can power a ship for a whole lifetime of up to 30 years and longer.
- Nuclear is the ONLY clean energy source that can reliably power the production of low carbon fuels, like ammonia and methanol - for small ships.

Floating nuclear, nuclear power stations in nearshore waters and nuclear-powered ships – built in shipyards - where the workforce is stable, and fully trained - allows for true modularity of construction which gives us reliable costs and timely deliveries.

We know that Floating nuclear works because Nuclear Power has been used in nuclear navies for over 70 years - since the 1950s.

Nuclear navies have proven that reactors can be operated safely at sea, tolerating pitching, rolling, and heaving with the ocean, and travelling millions of miles - without refuelling, on ZERO emissions.

But these 'naval reactors' cannot be insured commercially.

This means we cannot bring them into ports or nearshore environments.

That is a showstopper. - And it is where we are today.

We therefore need NEW nuclear solutions, - and we need relevant standards for those new solutions - so they can be prototyped, demonstrated, and adopted - to solve the immensely difficult dual challenge of both meeting our global climate goals and improving our energy efficiency.

Here at the IMO - that starts with SOLAS Ch 8, Code of Safety for Nuclear Merchant Ships (known as Res A.491.Xii) – or the Code as we call it - which you all passed and adopted back in 1981 – 43 long years ago, - and which is now long overdue a major revision to bring it into the modern age.

WNTI gap analysis of A.491(Xii) - Submitted as MSC108/INF.21



→ *Goal based.*

→ *Technology agnostic.*

→ Suitable for all organisations in the process.

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When I spoke with you at MSC106 in 2022, and then again at MEPC 80 last summer, I promised to deliver the results of a significant piece of work that has been 2 years in the making.

I promised you that the World Nuclear Transport Institute - WNTI, together with the world's foremost experts in nuclear and maritime safety, would present you with a FULL, technical gap analysis of the Code of Safety for Nuclear Merchant Ships.

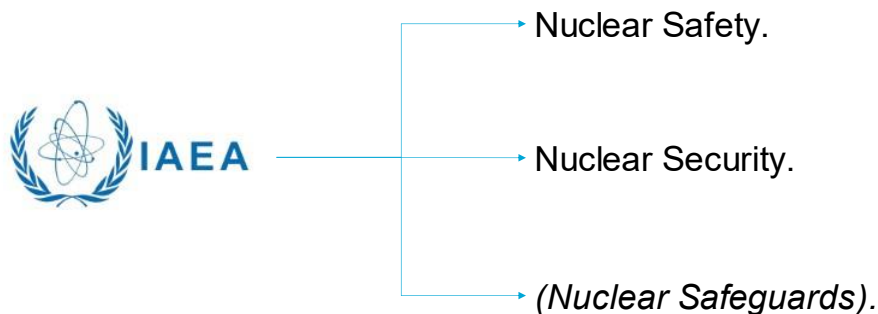
I hold here in my hand that completed gap analysis.

Our experts have painstakingly gone through every aspect, line by line, issue by issue - as it was set out in the 1970s - and linking each of those to the current globally accepted standards - for both maritime and nuclear safety - that apply today.

We have submitted the analysis to this Committee through **MSC 108/INF.21**, where we demonstrate how the Code can be revised so that it can be – goal based - technology agnostic – and in a form that is suitable for all organisations involved - in both the design and safety assessment process - including plant designers, plant licensees, plant operators and independent verifiers.

We believe this important gap analysis is the key for you to recommend the approval to commence the important work of revising the code, either here and now - at MSC108 - or later this year at MSC109.

IAEA TECDOC - gap analysis for floating nuclear power as regards:



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As you embark on that journey - You will not be alone.

You will be one of three main parts of the ecosystem of standards that will govern nuclear power at sea.

The second part is nuclear safety, security, and safeguards – whose guardian is the International Atomic Energy Agency (the IAEA) based in Vienna.

Last week, the director-general of the IAEA, Mr Rafael Grossi, called publicly for a roadmap for nuclear energy to become a viable option to reduce commercial shipping's global greenhouse gas emissions.

He said – and I quote: *'As the world increasingly turns to nuclear for sustainable development, we expect to see further advancements, including in the maritime sector to decarbonize shipping — which is a key objective of the International Maritime Organization'*.

As a result, members of the IAEA secretariat have attended meetings here at MSC108 to observe and discuss how their current work on floating nuclear can be coordinated with work that should now commence here at the IMO.

We are also making our Gap analysis of the Code - available to the IAEA - and to your colleagues who represent you there.

That Agency is now performing their own Gap analysis looking at their side of the standards and regulations which cover nuclear safety and nuclear security, - and how those will apply to floating nuclear power.

What they will find - is that the link between these two parts of the ecosystem of standards - which apply to floating nuclear and nuclear-powered ships – (you here at the IMO - and they at the IAEA) - is this Code of Safety for Nuclear Merchant Ships

When -, and I believe it is a question of WHEN and not IF – these two key parts of the regulatory ecosystem are joined together to form the foundation for a new era of ocean transportation that shows the world that we can both eliminate **GHG** - AND improve our energy efficiency – we can demonstrate to the world - that it can in fact - be done.

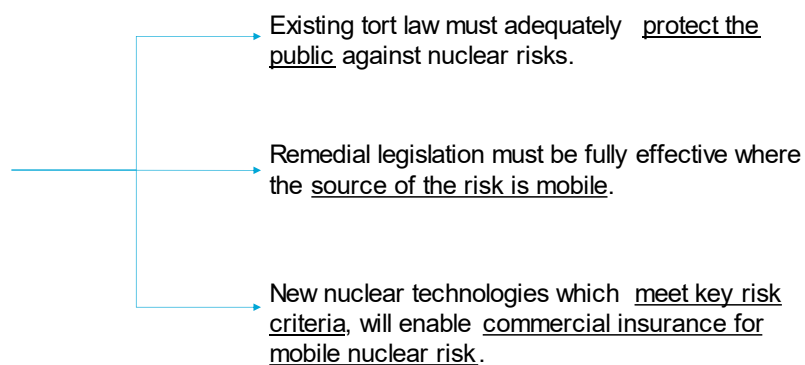
We have ignored this issue for 43 years, but we cannot ignore it any longer.

Slide 4. – Building a Liability convention



Key criteria for liability and commercial insurability

Nuclear liability conventions



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The third part of the ecosystem of standards which must apply to floating nuclear and nuclear-powered ships - is liability insurance.

Without commercial liability insurance, nuclear powered ships cannot enter ports, and we will be stuck where we are today, with no nuclear solution - to solve our TWO big challenges.

For insurers to underwrite - and re-insure commercial floating nuclear power, an internationally agreed convention of liabilities must be adopted.

Today - both the existing nuclear liability conventions - known as the Vienna and Paris Conventions - exclude nuclear powered ships.

This is because the technology for which the IMO Code was written -and the non-insurability of that technology in a commercial merchant ship, - prevents nuclear liability insurance of mobile reactors.

Here is why:

Despite the outstanding safety record of the nuclear industry - and - that there has never been a major nuclear incident involving large-scale damage outside the installation site, - existing tort law does not adequately protect the public against nuclear risks on a national basis, where the source of the risk is mobile, as it would be on a nuclear-powered ship.

We therefore need a modern liability convention based on a new and improved narrative that allows such commercial insurability.

On the 25th of May 1962, (62 years ago this week) the 'Brussels Convention on the Liability of Operators of Nuclear Ships' was about to be signed after a very large majority of the more than fifty participants of that year's Diplomatic Conference on Maritime Law, - including the United Kingdom, France, Japan, and most Western European countries, found that the United States, the Soviets and the Eastern European countries under the Warsaw Pact - refused to sign and the Convention was never ratified.

Since the United States had been one of the earliest sponsors of a convention in this field, and since the nuclear ships at the time were being operated solely under American and Soviet flags, the result was disappointing.

Today our situation is different.

Today, it comes down to established practices - and the conditions for how floating nuclear and nuclear ships can be commercially insured.

For remedial legislation to be fully effective - where the reactor – the insured source of risk - is mobile, as it is with a nuclear ship - new nuclear technologies - which can resolve the challenge of insurability - must satisfy TWO main criteria.

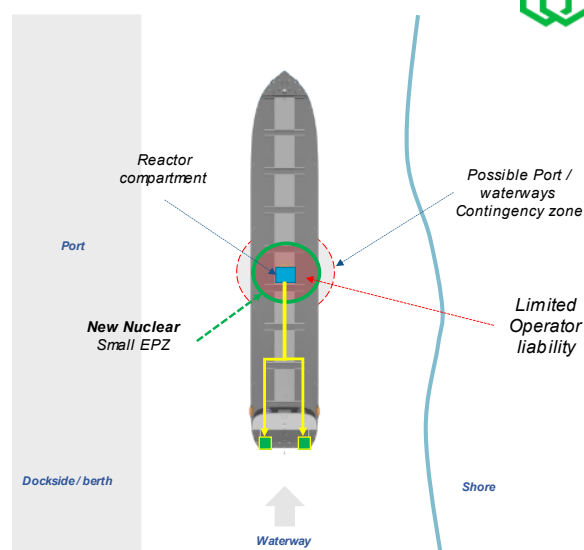
Slide 4 a - EPZ

'New nuclear' in waterways

No-low pressure =
Small EPZ.

Small 'mobile' EPZs =
Easy to insure.

Nuclear electric =
Only reactor is 'nuclear'.



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I've shown you this illustration before – but it is worth repeating.

First - The Emergency Planning Zone (EPZ) – legally required around the reactor - must be minimal, preferably contained entirely within the confines of the ship's hull.

As you can see in this illustration, the EPZ does not extend beyond the boundaries of the hull – minimizing the hazardous zone in the event of an accident.

With no large-scale damage possible outside the installation site – which in our case would be the hull of the ship - tort law can apply and therefore adequately protect the public - against nuclear accident risks.

This will facilitate the development of commercial insurance and open the door for waterways navigation and port calls for nuclear powered ships.

Second - NEW nuclear power systems must be passively safe under all conditions - and meet or exceed the highest standards set for security and safeguards by design.

New nuclear technologies which meet these two criteria will open the possibility of nuclear propulsion for large, ocean-going ships.

The Fourth IMO GHG Study (2020) identifies over 12,500 ships (containers, tankers, bulk carriers, cruise vessels, reefers etc) - where the case could be made for using nuclear propulsion.

Our estimate is that such a fleet would reduce GHG emissions from shipping by up to 70%. – and, with relevant standards in place - can be built in the coming decades - to 2060.

With new nuclear technologies that are commercially insurable - a revised and modern liability convention can be adopted for the first time - and open the possibility for such amazing results to be achieved.

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Shipowners, shipyards, trading houses and banks - which control almost 5,000 ships have to date made financial investments in companies building these new nuclear technologies and the industry now has nuclear-powered ships on the radar for commercial launch in the 2030s.

Modular construction in shipyard production is a key strategy for scaling nuclear deployment.

Both nuclear-powered ships and Floating Nuclear Power Plants (FNPPs) can be centrally manufactured - using common parts and components. This allows complete predictability of both cost and delivery times, which is an unusual feature in the nuclear industry.

Mr Grossi of the IAEA said last week - that we need a roadmap for the entire ecosystem - to underpin these wonderful new solutions to shipping's GHG emission and energy efficiency challenges.

We believe – at a high level - such a roadmap can look like this.

Slide 5. - The roadmap



Roadmap to 2030s

Step 1:	2024 - 2026	<u>IMO revises Res. A.491(Xii)</u> in close dialogue with the IAEA .
Step 2:	2024 - 2026	IAEA completes gap analysis of <u>standards for floating nuclear</u> in close dialogue with IMO .
Step 3:	2026 - 2028	Insurance industry use resulting unified standards as a <u>foundation for Liability Convention</u> .
Step 4:	2028 - 2030	Member states set down rules for <u>floating nuclear to transit waters, enter and operate in waterways and make port calls</u> .
The end game:	2030 +	Fit-for-purpose technology is <u>coming to market in early 2030s</u> .

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Step 1 – You - the delegates of the IMO, commence the revision of 491(Xii) and in dialogue with the IAEA - complete that work over the next few years.

Step 2 – The IAEA completes its gap analysis of all current standards for nuclear safety and nuclear security - and identifies the gaps, then coordinate filling those gaps with you here at the IMO.

The result would be a closely knit - internationally accepted - set of standards for floating nuclear- and nuclear-powered ships that meet or exceed the highest standards for safety and security, that are goal based, technology agnostic and fit-for-purpose for commercial insurability.

Step 3 – the insurance industry – H&M insurers, - P&I Clubs, - nuclear risk insurers - and the re-insurance industry - can then use that internationally accepted set of standards as a foundation for a fresh Liability Convention - that sets out how remedial legislation is fully effective when the insured risk is mobile.

Step 4 – nation states, - members of the IMO and IAEA - which have both a competent maritime and nuclear regulator - set down their domestic rules for how floating nuclear- and nuclear-powered ships can transit their waters, - enter and operate in waterways - and make port calls.

Some nations will also set rules and guidelines for the design and construction of such assets - and will want to have such assets flagged domestically.

We expect to see these new nuclear technologies fully commercialised in the early 2030s – between 6 and 10 years from now.

It is therefore imperative that we take the first step now - by revising the Code of Safety for Nuclear Merchant Ships.

We will be seeking your support to co-sponsor a proposal to get this important work started.

Slide 6. – Introducing NEMO

Industry support for member states.



Voice of nuclear transport industry.

50+ members.

6 working groups including:

WNTI Marine Applications and Nuclear Propulsion Group (MANPG).

Existing NGO status at IMO and IAEA.



The voice of the nuclear mobility industry.

10 founding members (40 by end 2024)

3 Working Groups:

Maritime nuclear
Nuclear maritime
Liability.

Will apply for NGO status at IMO and IAEA.

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WNTI has for many years been a lone voice of nuclear transport here at the IMO. Our organisation records over 20 million shipments of nuclear material every year - with a near 100% safety track record for the last 50 years. – **Nothing** is safer than nuclear transport. But our work is never done - we always strive for progress.

WNTI will continue to be laser focused on the safe shipments of nuclear material – nuclear fuel - and medical radioisotopes so that lives can be saved. But we must add voices to the choir.

This year – 10 leading companies developing new technology solutions, class rules, insurance, and manufacturing facilities for floating nuclear- and nuclear-powered ships – got together and formed and international trade body called the 'Nuclear Energy Maritime Organization' – NEMO. A further 30 members from around the world are now queuing to join.

NEMO will - together with WNTI - spearhead the essential work to assist you here at the IMO and your colleagues at the IAEA - with the modernisation of the entire regulatory ecosystem for nuclear-powered ships and FNPPs.

Later this year, NEMO expects to make its own application to become an observer NGO here at the IMO - to assist you in this important work - and will seek your support for this application.

Our common aim is to have a fit-for-purpose ecosystem of rules and regulations established by 2030.

Slide 7: - Thank you, Q&A and Drinks



Thank you.

Q&A



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Please join our drinks reception upstairs afterwards.

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With that ladies and gentlemen - I wish to thank you again for your attention - and I encourage you to reach out to us to - engage, - learn, participate - and influence developments for a **positive outcome.**

I will of course be happy to answer your questions - and look forward to seeing you all at our drinks reception upstairs - after this session.

Thank you.