

Breakout Session 3: Engineering (Structure & Fire)

Antoine CASSEZ
Stéphane PABOEUF





Why breaking the 500 UMS barriers?

- We already reached the limit
- It's the way that technology history is going (aeronautics, automotive, railway, etc...)
- It's a new business lead for shipyards
- It's green development compliant
- It's money saving for customers (less petrol and corrosion)



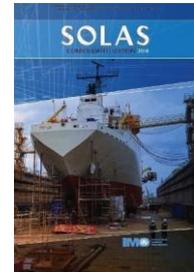
Classification societies' rules

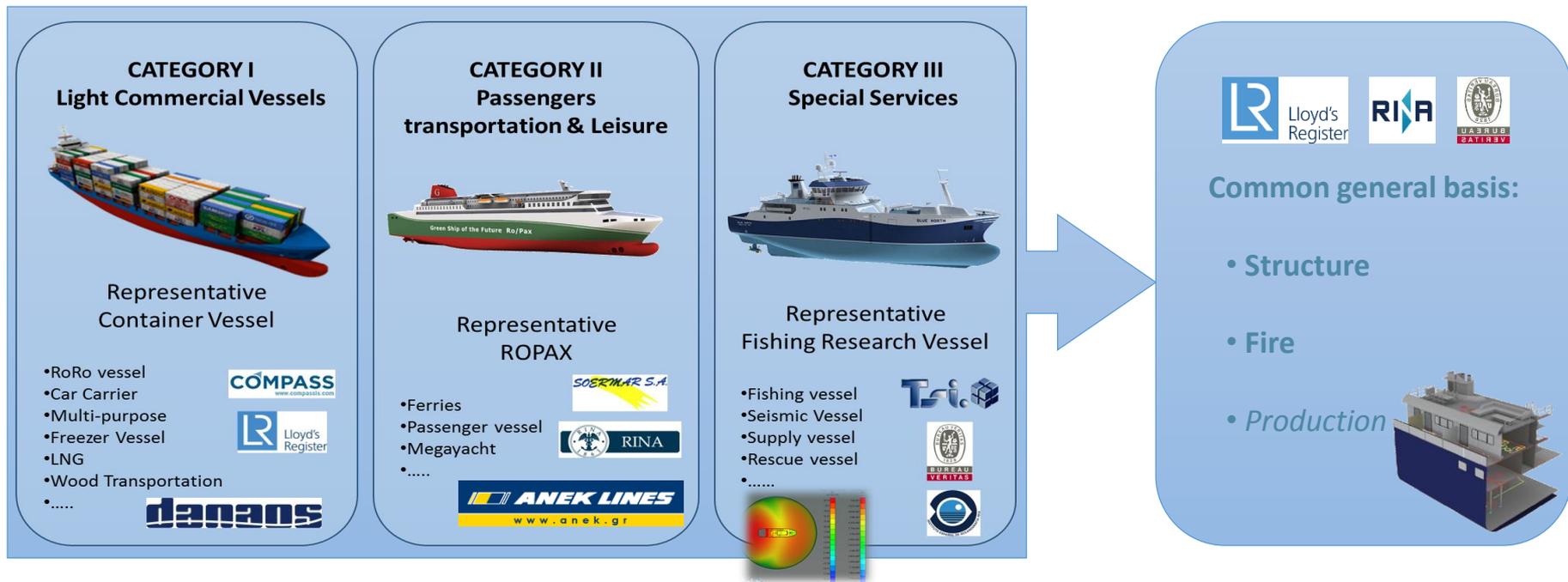
- BV: NR396, NR500, NR546, NR600, NI590, NI603, NI613
- LLOYDS: Rules and Regulations for the Classification of Special Service Craft
- RINA: RSE.06/E, RES.22/E, RES.23/E, RES.24/E, naval ships



International regulations

- SOLAS, Chapter II-2
- MSC/Circ. 1002 – Guidelines on alternative design and arrangement for fire safety
- MSC.1/Circ.1455 Guidelines for the approval of alternatives and equivalents as provided for in various IMO instruments
- MSC.1/Circ.1574 Interim guidelines for use of fibre reinforced plastic (FRP) elements within ship structures: Fire safety issues

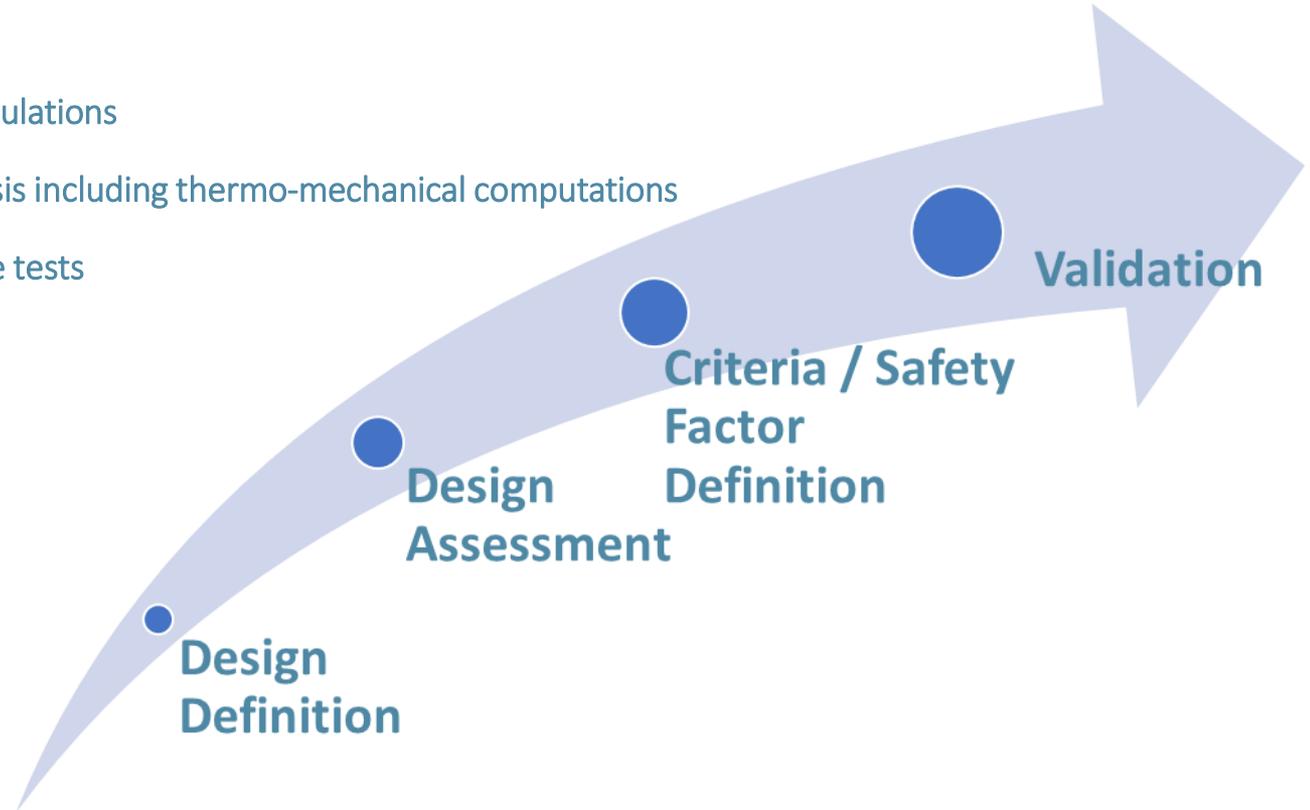




STRUCTURE

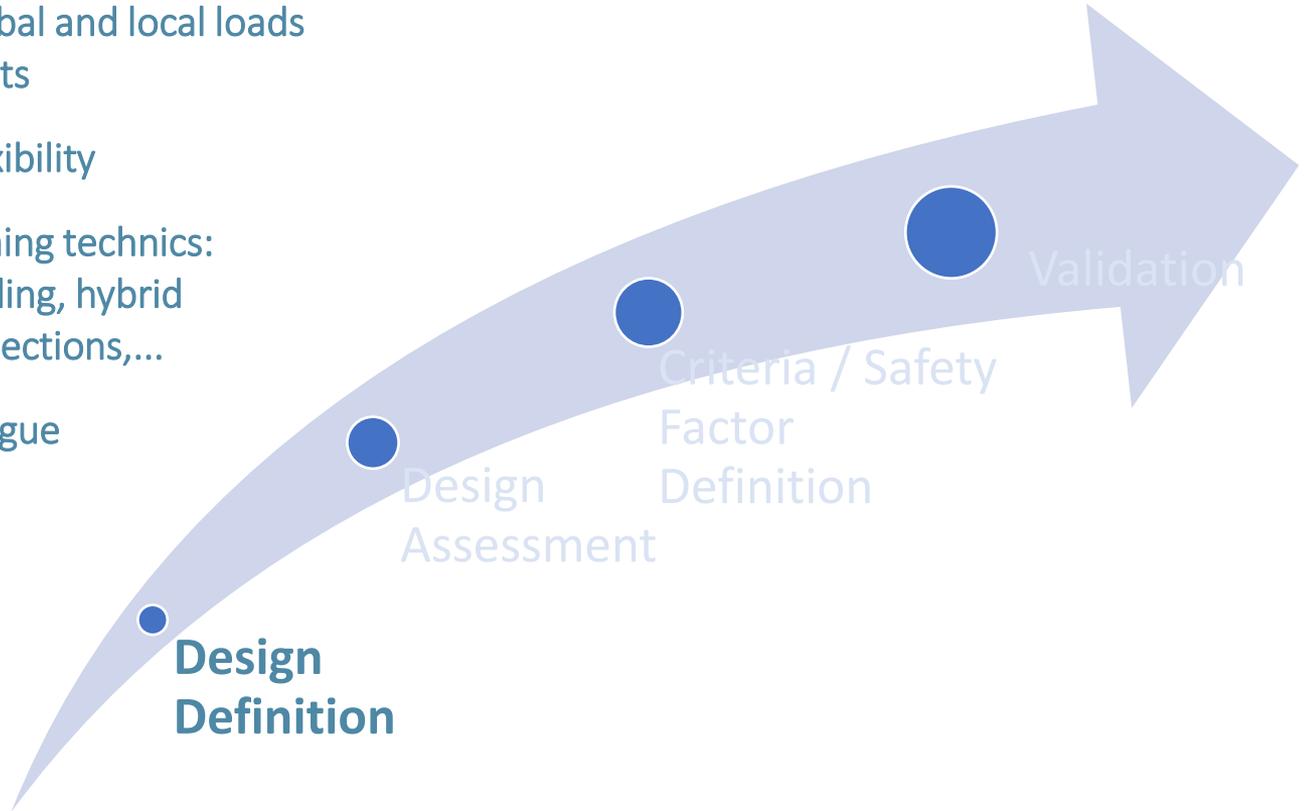
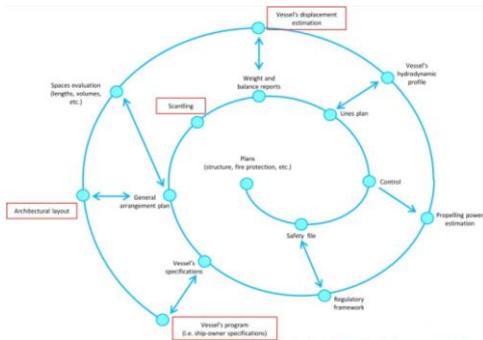
Development of performance criteria and project guidelines

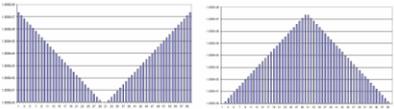
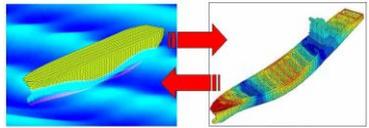
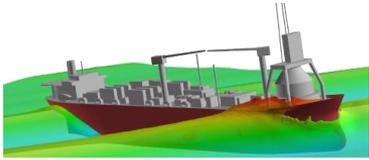
- Based on:
 - Existing rules and regulations
 - Finite Element Analysis including thermo-mechanical computations
 - Model scale/full scale tests





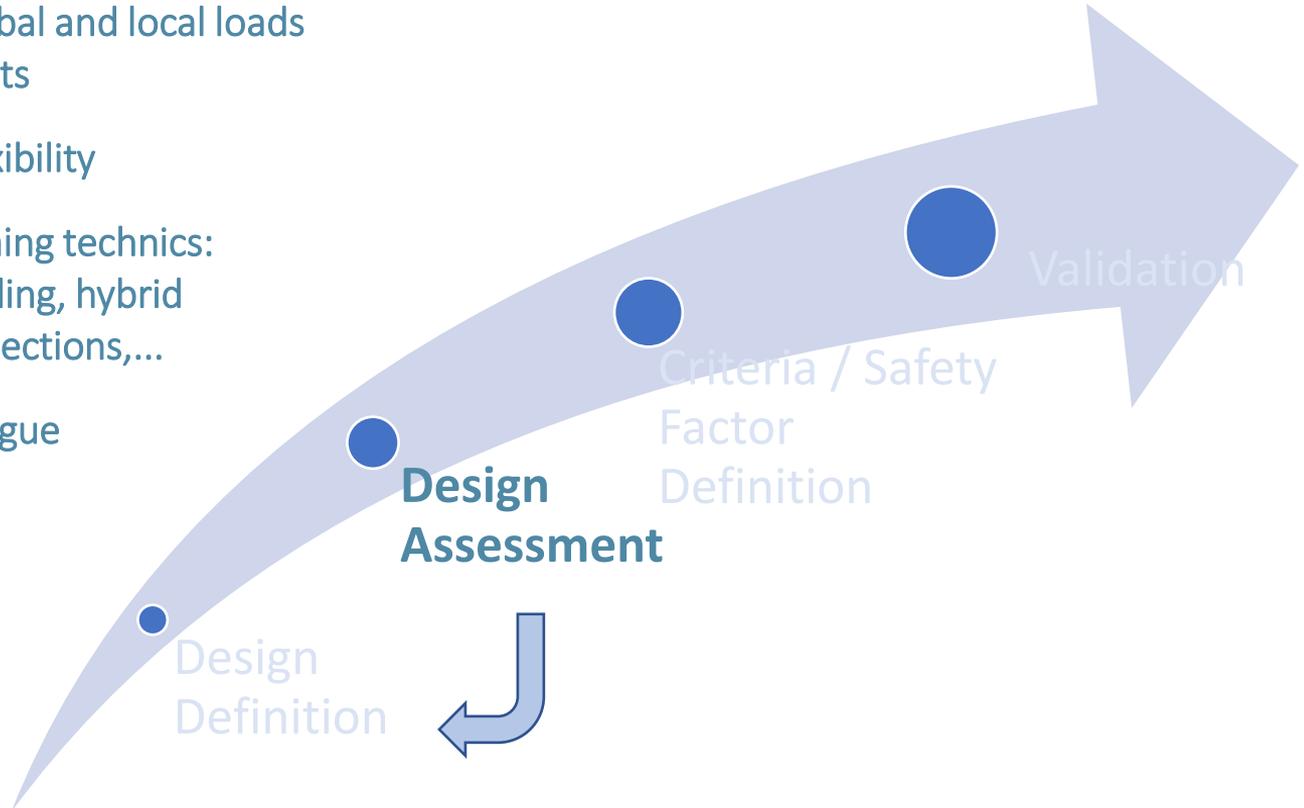
- Global and local loads effects
- Flexibility
- Joining technics: bonding, hybrid connections,...
- Fatigue

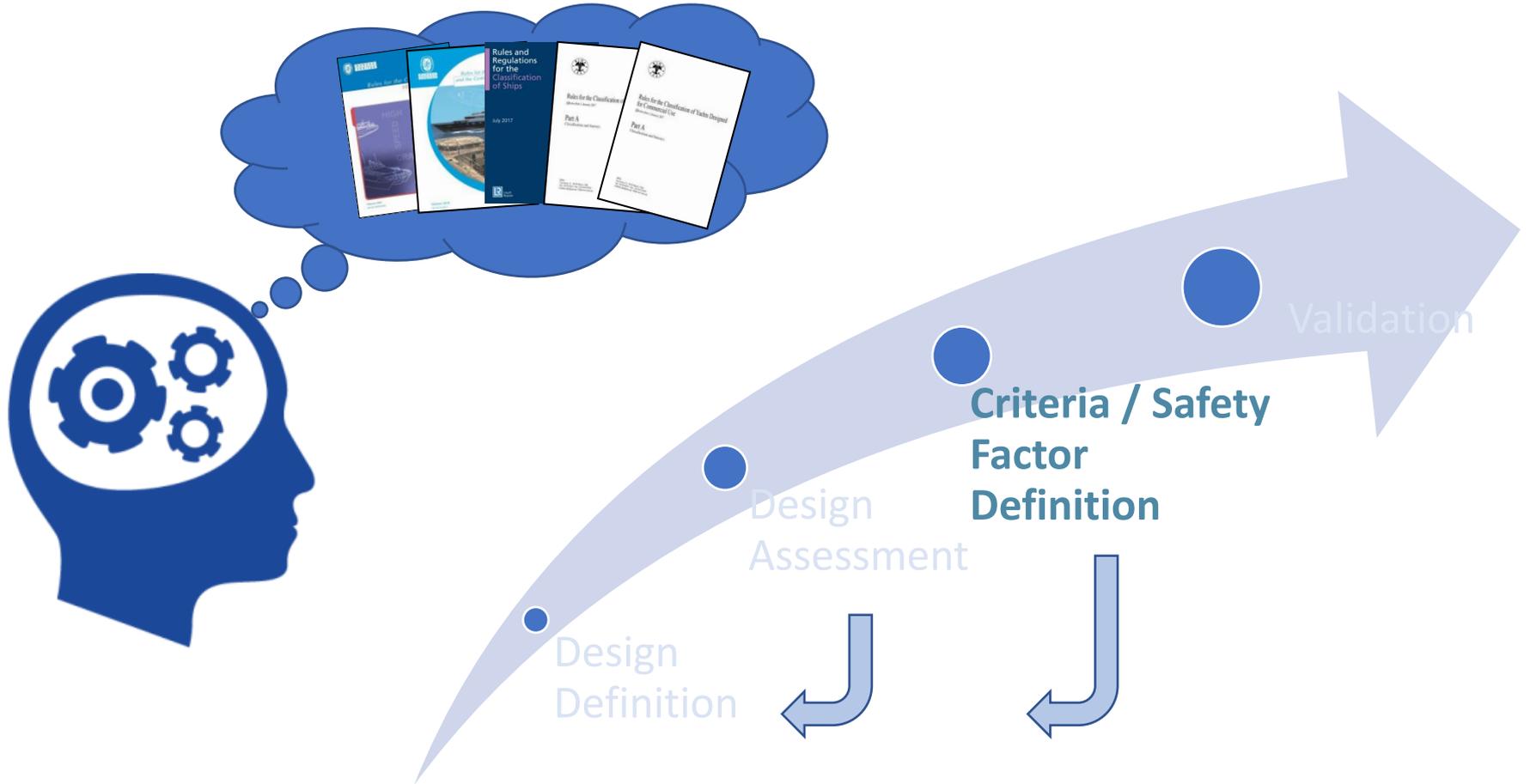


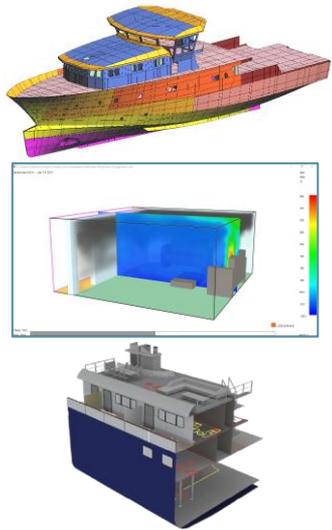


- Global and local loads effects
- Flexibility
- Joining technics: bonding, hybrid connections,...
- Fatigue

- *Crashworthiness*
- *Slamming, whipping...*
- ...





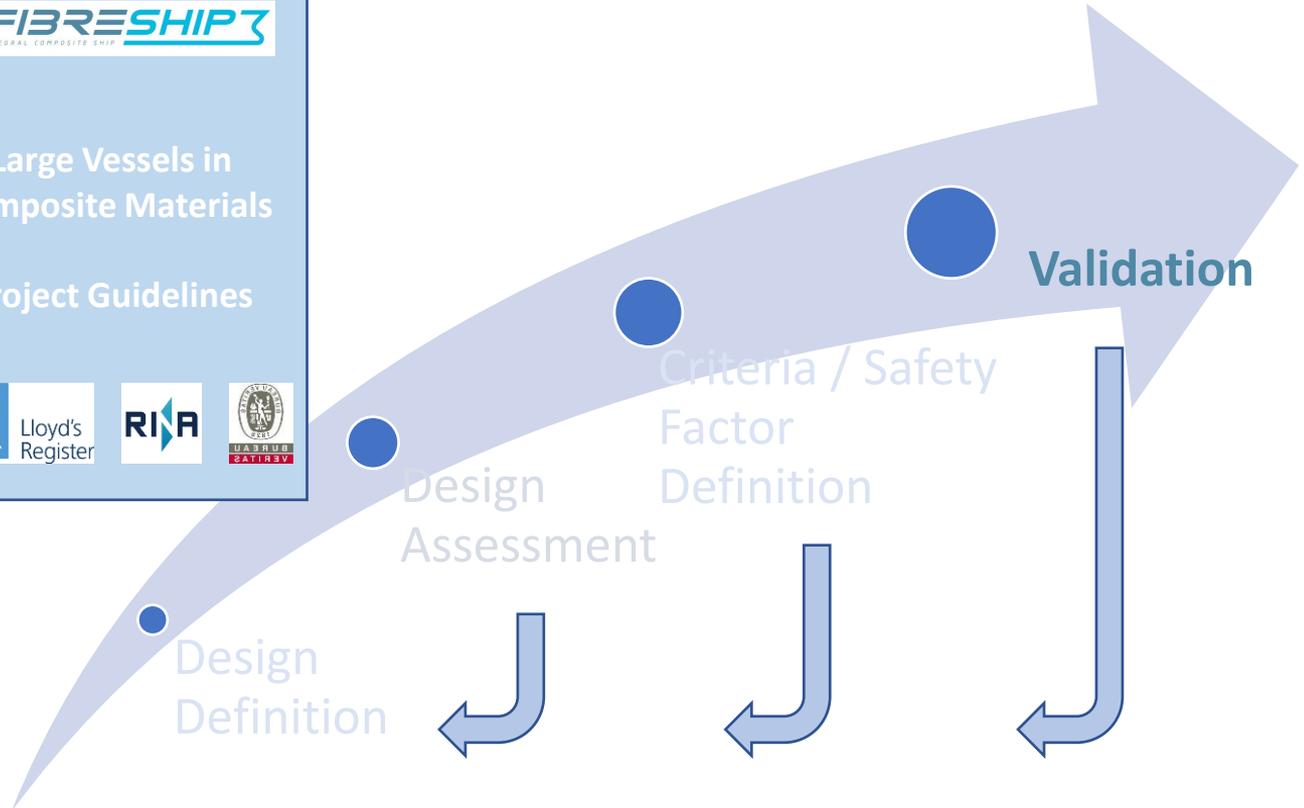


FIBRESHIP 3
INTEGRAL COMPOSITE SHIP

Large Vessels in
Composite Materials

Project Guidelines

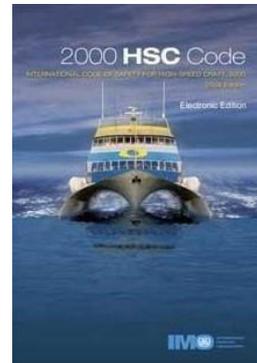
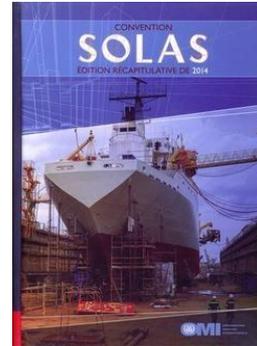
Lloyd's Register



FIRE SAFETY ISSUES

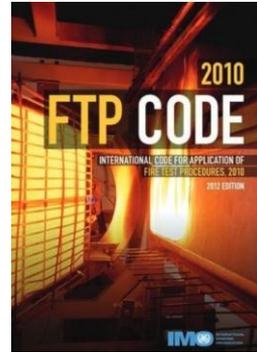
Fire Safety Issues – Regulatory context

- ✓ Fire safety objectives (SOLAS Chap. II-2, Reg. 2):
 - Prevent the occurrence of fire and explosion
 - Reduce the risk to life caused by fire
 - Reduce the risk of damage caused by fire to the ship, its cargo and the environment
 - Contain, control and suppress fire and explosion in the compartment of origin
 - Provide adequate and readily accessible means of escape for passengers and crew
- ✓ Functional requirements
 - Division of the ship into main vertical and horizontal zones by thermal and structural boundaries
 - Separation of accommodation spaces from the remainder of the ship by thermal and structural boundaries
 - Restricted use of combustible materials
 - Containment and extinction of any fire in the space of origin
 - Protection of means of escape and access for fire fighting
- ✓ General statements available for SOLAS vessels and High Speed Crafts (HSCs – 2000 HSC Code)



Fire Safety Issues – Regulatory context

- ✓ However, SOLAS vessels and HSCs are not submitted to the same prescriptive requirements
- ✓ Compliance with SOLAS & Fire Test Procedures Code (2010) regarding fire safety:
 - SOLAS vessel: SOLAS Chap. II-2 & **2010 FTP Code, Annex 1, Section 3**
 - HSC: SOLAS Chap. X & **2010 FTP Code, Annex 1, Section 11**
- ✓ Common basis:
 - *Non-combustible material* is a material which neither burns nor gives flammable vapours in sufficient quantity for self-ignition when heated to approximately 750°C (according to 2010 FTP Code)
 - *Combustible material* is any material other than a non-combustible material
 - *Steel or other equivalent material* means any non-combustible material which, by itself or due to insulation provided, has structural and integrity properties equivalent to steel at the end of the applicable exposure to the standard fire tests (e.g. aluminium alloy with appropriate properties)



Fire Safety Issues – Regulatory context

✓ SOLAS vessel – SOLAS Chap. II-2 & 2010 FTP Code, Annex 1, Section 3

- Globally:
 - Decks: A Class (A0, A15, A30 or A60)
 - Bulkheads: A Class (A0, A15, A30 or A60)
or B Class (B0 or B15)
or C Class

Fire Division Classification	Material requirement	Fire test duration	Flame tightness (for the whole duration of the test)	Smoke tightness (for the whole duration of the test)	Thermal insulation requirements			Load bearing structure	Specimen size
					Average temperature rise on the unexposed face	Maximum temperature rise on the unexposed face	Temperature insulation successful up to		
A	A0	Steel or equivalent	Yes	Yes	/	/	/	/	Bulkhead : 2,42 m x 2,48 m Deck : 2,42 m x 3,02 m
	A15				140 °C	180 °C	15 min		
	A30						30 min		
	A60						60 min		
B	B0	Non-combustible material	Yes	No	/	/	/	/	Bulkhead : 2,44 m x 2,5 m Deck : 2,44 m x 3,04 m
	B15				140 °C	225 °C	15 min		

- Class “C” class division:
 - No requirement relative to passage of fumes and flames
 - No requirement relative to temperature rise
- Always of non-combustible materials

Fire Safety Issues – Regulatory context

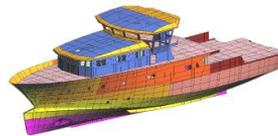
- ✓ HSC – SOLAS Chap. X & 2010 FTP Code, Annex 1, Section 11
 - Introduction fire-resisting divisions (FRD) and fire-restricting material
 - *FRD* are divisions formed by bulkheads and decks which comply with the following:
 - Constructed of non-combustible or fire-restricting materials which by insulation or inherent fire-resisting properties satisfy the requirements:
 - Suitably stiffened
 - A test of a prototype bulkhead or deck in accordance with the 2010 FTP Code (cf. below)
 - Constructed as to be capable of preventing the passage of smoke and flame up to the end of the appropriate fire protection time
 - Where required they shall maintain load-carrying capabilities up to the end of the appropriate fire protection time
 - Shall have thermal properties (cf. table below)

Fire Division Classification	Material requirement	Fire test duration	Flame tightness (for the whole duration of the test)	Smoke tightness (for the whole duration of the test)	Thermal insulation requirements			Load bearing structure	Specimen size
					Average temperature rise on the unexposed face	Maximum temperature rise on the unexposed face	Temperature insulation successful up to		
<i>FRD</i>	Fire restricting or non-combustible material	30 min	Yes	Yes	140 °C	180 °C	30 min	Bulkhead : 7 kN/m of width Deck : 3,5 kN/m ² of area	Bulkhead : 2,44 m x 2,5 m Deck : 2,44 m x 3,04 m
		60 min					60 min		

- ✓ HSC – SOLAS Chap. X & 2010 FTP Code, Annex 1, Section 11
 - *Fire restricting material*: material that shall comply with 2010 FTP Code, Annex 1, Part 10
 - Different test procedures and criteria for:
 - Surface materials on bulkheads, wall and ceiling lining, including their supporting structure
 - Materials used for furniture and other components
 - Examples of criteria:
 - Time to ignition
 - Maximum 30-second sliding average heat release rate
 - Flame spread
 - Smoke production rate
 - Etc.

- ✓ Selected materials themselves can not satisfy the actual regulatory context
- ✓ What we need to move forward: a new methodology

- Develop a design for each vessel



- Identify the new risks raised by the use of FRP on-board such vessels

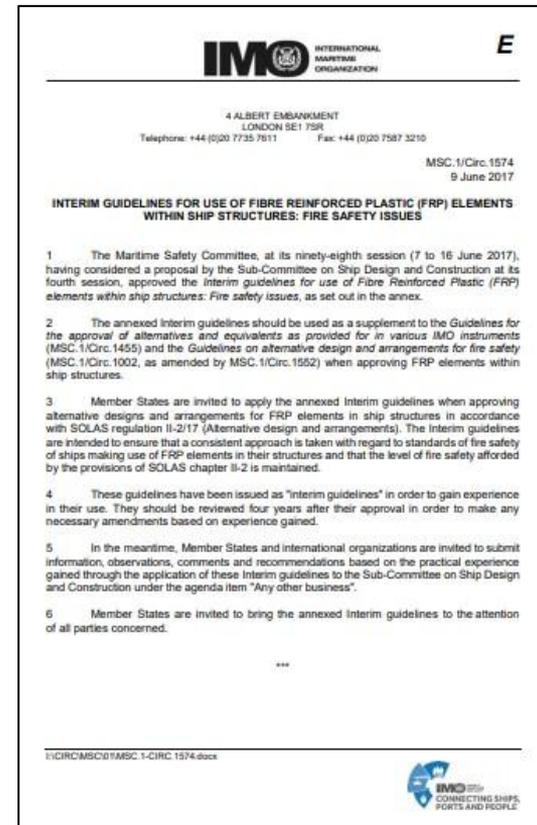


- Consider a fire safety engineering approach to develop new performance criteria for FRP materials to prove that SOLAS fire safety objectives and functional requirements can be met

✓ What should be assessed?

- Probability of ignition
- Fire growth potential
- Potential generation of smoke and toxic products
- Containment of fire
- Firefighting
- Structural integrity

✓ In accordance with MSC.1/Circ. 1574



✓ Examples

- New standards for fire resistance test procedures
- New acceptance criteria for fire resistance tests
- New standards for fire protection effectiveness
- New life safety performance criteria
- New standards for fire detection and firefighting
- ...

Discussion

Structure & Fire



FIBRESHIP 3
INTEGRAL COMPOSITE SHIP

www.fibreship.com

