E-LASS Seminar and 2nd Workshop of the Maritime Advisory Group (MAG)

June 12th, 2019

Vigo, Spain

Rules & Regulations: Fast Track to Approval

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Bureau Veritas Marine & Offshore

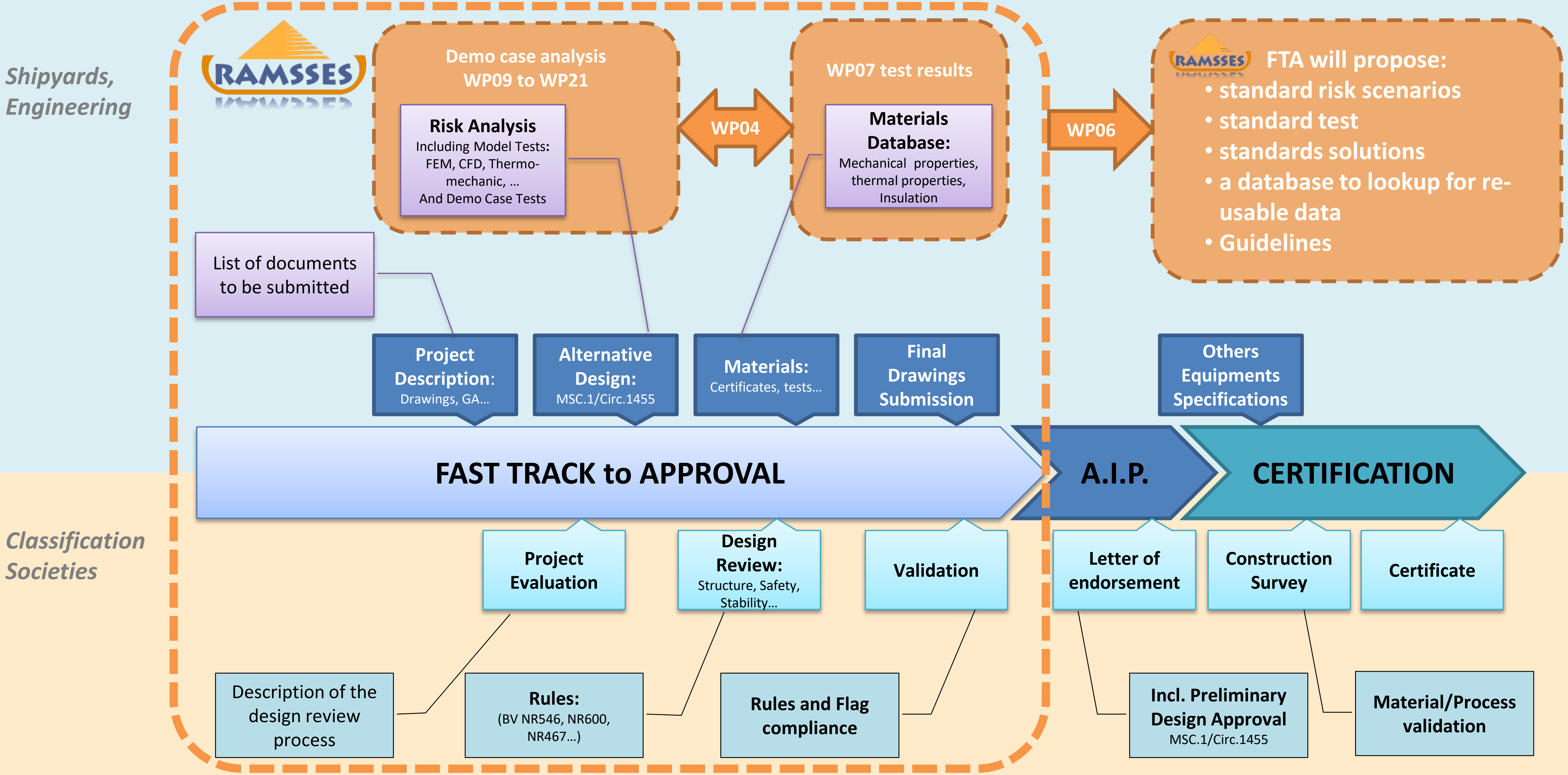
Agenda

1. Fast Track to Approval
   – Process reminder

2. Application Case
   – Damen
   – Conclusion

3. Dissemination
   – Conferences
   – IMO
   – Workshops

1. FAST TRACK to APPROVAL



Project Description: Drawings, GA…

Alternative Design: MSC.1/Circ.1455

Materials: Certificates, tests…

Final Drawings Submission

FAST TRACK to APPROVAL

Project Evaluation

Design Review: Structure, Safety, Stability…

Validation

Main Characteristics		
Length	86.0	m
Beam	15.0	m
Depth to main deck	6.0	m
Speed	15	Knots
Crew	59	Persons

I ✠ HULL ✠ MACH
(Class Symbol, Construction mark)
Offshore Patrol Vessel - OPV
(Structural type notation – Service notation)
Unrestricted
(Navigation notation)
✠ AUT-UMS ✠ SP59
(Additional services features)

2. FTA – Damen Application Case

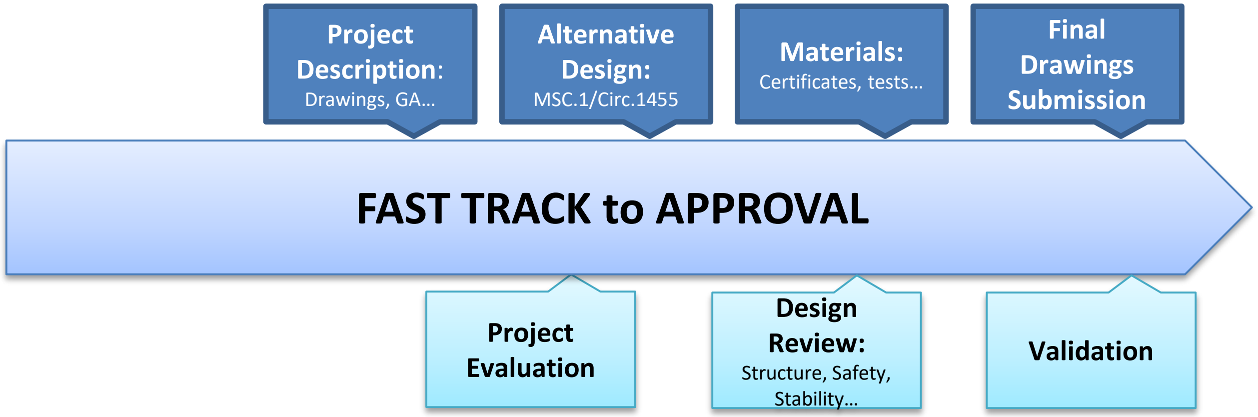


Table 1 : Applicable requirements

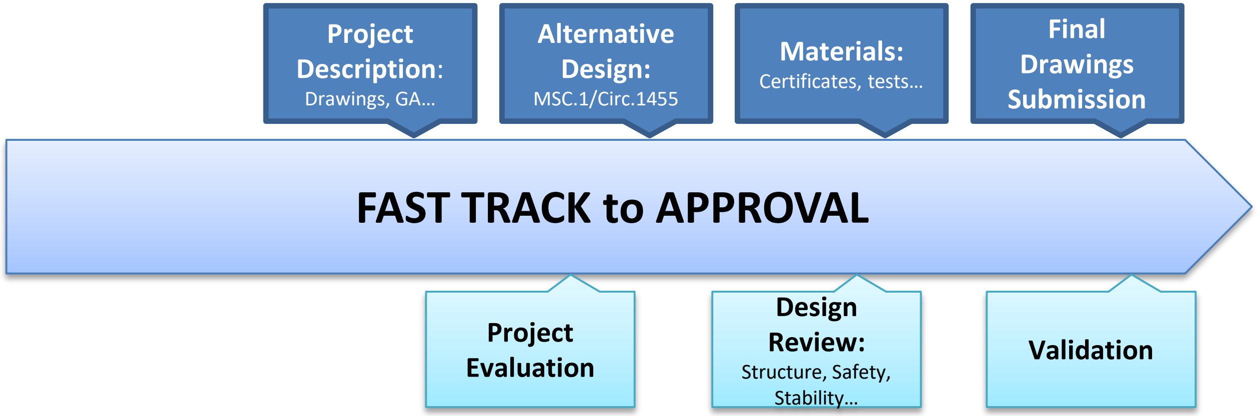
Item		Greater than or equal to 500 GT	Less than 500 GT
Ship arrangement and hull integrity	L ≥ 65 or 90 m **(1)**	• Part B • Part C, Chapter 1 **(2)**	• NR566 **(3)**
	L < 65 or 90 m **(1)**	• NR600 • Part C, Chapter 1 **(2)**	• NR566 **(3)**
Hull	L ≥ 65 or 90 m **(1)**	• Part B • NR396 **(4)**	• Part B • NR396 **(4)**
	L < 65 or 90 m **(1)**	• NR600 **(3)**	• NR600 **(3)**
Stability		• NR566 • Ch 16, Sec 2	• NR566 • Ch 16, Sec 2
Machinery		• Part C • Ch 16, Sec 3	• NR566 **(3)** • Ch 16, Sec 3
Electrical installations and automation	N ≤ 60 **(5)**	• Part C	• NR566 **(3)**
	N > 60 **(5)**	• Part C • Ch 16, Sec 4	• NR566 **(3)** • Ch 16, Sec 4
Fire protection, detection and extinction		• See Tab 2	• See Tab 2

Table 2 : Applicable requirements for fire safety

		Greater than 1000 GT	Between 500 and 1000 GT	Less than 500 GT	
				Unrestricted navigation	Restricted navigation
Steel or aluminium material	N ≤ 60	• Part C, Chapter 4 • Ch 16, Sec 5	• NR566	• NR566	• NR566
	N >60 **(1)**	• Part C, Chapter 4 • Ch 16, Sec 5	• Part C, Chapter 4 • Ch 16, Sec 5	• Part C, Chapter 4 • Ch 16, Sec 5	• NR566 • Ch 16, Sec 5
Composite material	N ≤ 60	NA **(2)**	• NR566	• NR566	• NR566
	N >60 **(1)**	NA **(2)**	NA **(2)**	NA **(2)**	• NR566 • Ch 16, Sec 5

(1) Offshore patrol vessels with more than 200 persons will be subject to special consideration by the Society.
(2) The present Chapter does not include this case (NA = not applicable).

2. FTA – Damen Application Case



MSC.1/Circ.1455 Guidelines for the approval of alternatives and equivalents as provided for in various IMO instruments

- Hull fire safety
  - **Ship could stay safely afloat for 3 hours** to allow for either return to port, intervention from another ship or evacuation of the persons on board.
    - Detection System
    - Ventilation
    - Fixed firefighting
- Helicopter deck
  - Hazid
  - Design fire scenarii

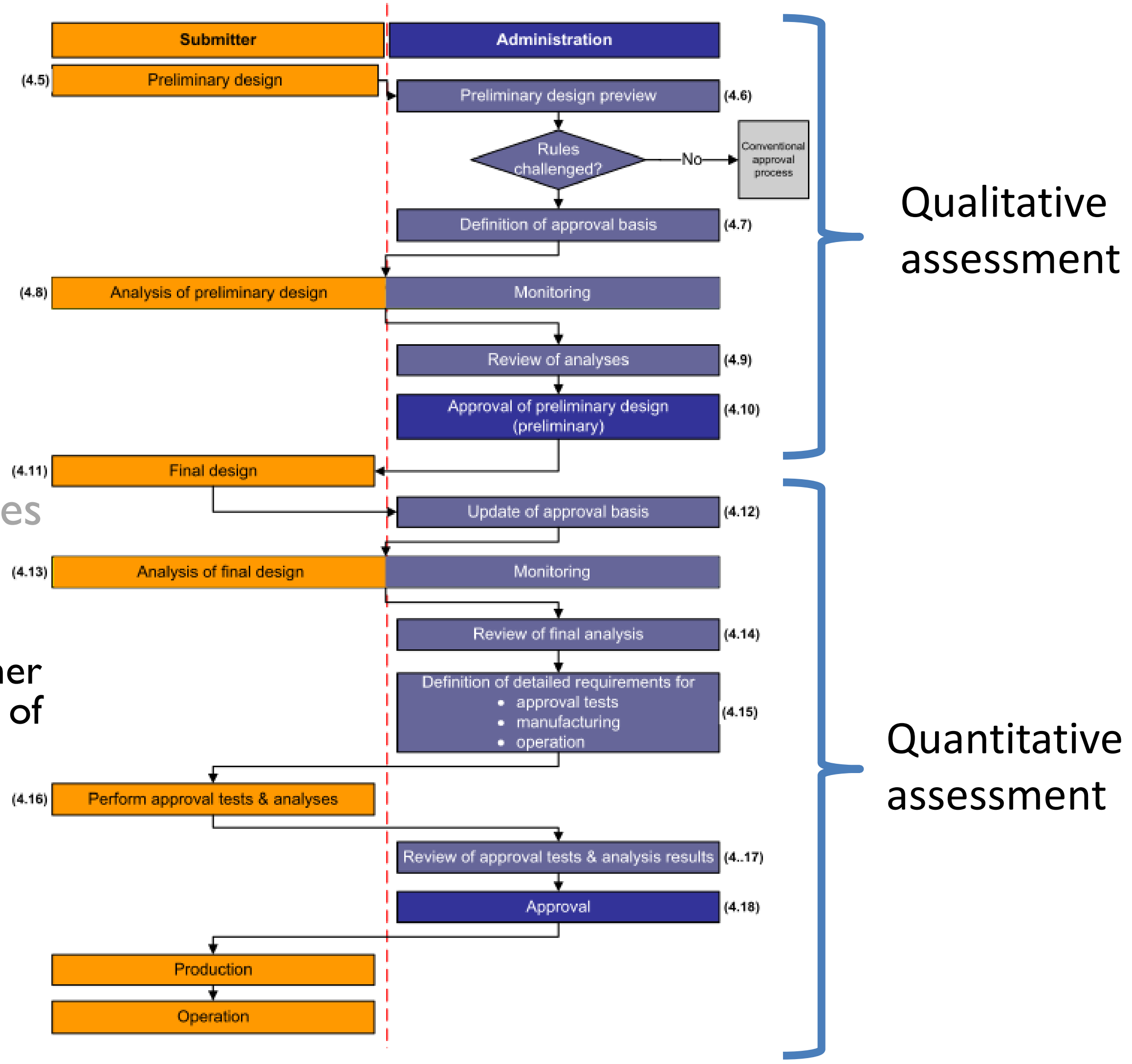
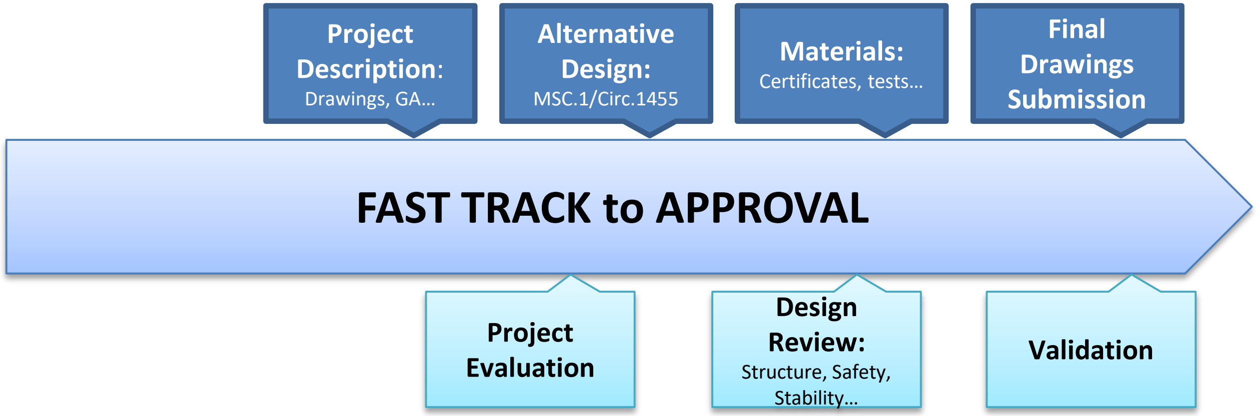


Figure 2: Design and Approval Process

2. FTA – Damen Application Case



Fire testing – IMO FTP Code

- Cone calorimeter test – IMO FTP Code Part 10 (ISO 5660-1)
- Cone tools modelling and simulation
- Fire restricting material (FRM)
- Small-scale furnace test– IMO FTP Code Part 11 (ISO 834-12/30021)
- Helicopter deck

Specimen size:
Non-load bearing fire-resisting divisions
Bulkheads
Width: 2420 or 3020 mm
Height: 2480 mm
Decks
Width: 2420 mm
Length: 3020 mm

Load bearing fire-resisting divisions
Bulkheads
Width: 3000 mm
Height: 3070 mm
Decks
Width: 3000 mm
Length: 3440-6000 mm

2. FTA – Damen Application Case

Project Description: Drawings, GA…

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Materials: Certificates, tests…

Final Drawings Submission

FAST TRACK to APPROVAL

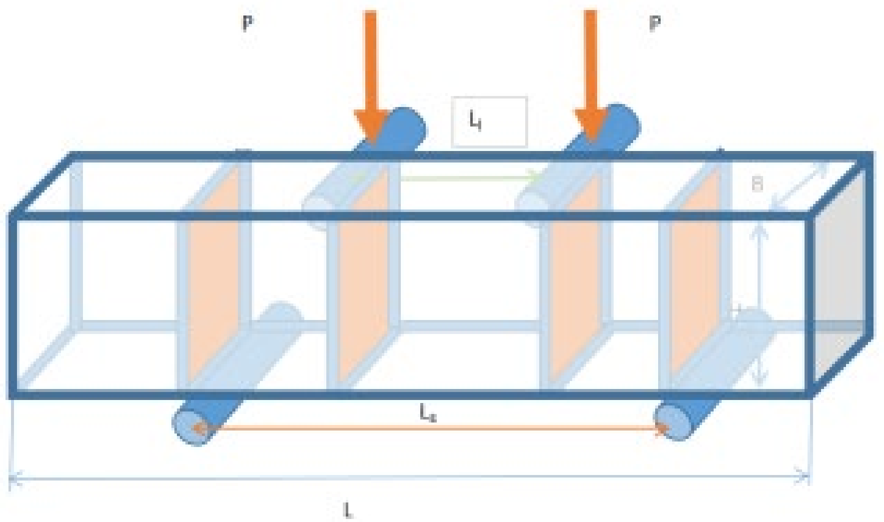
Project Evaluation

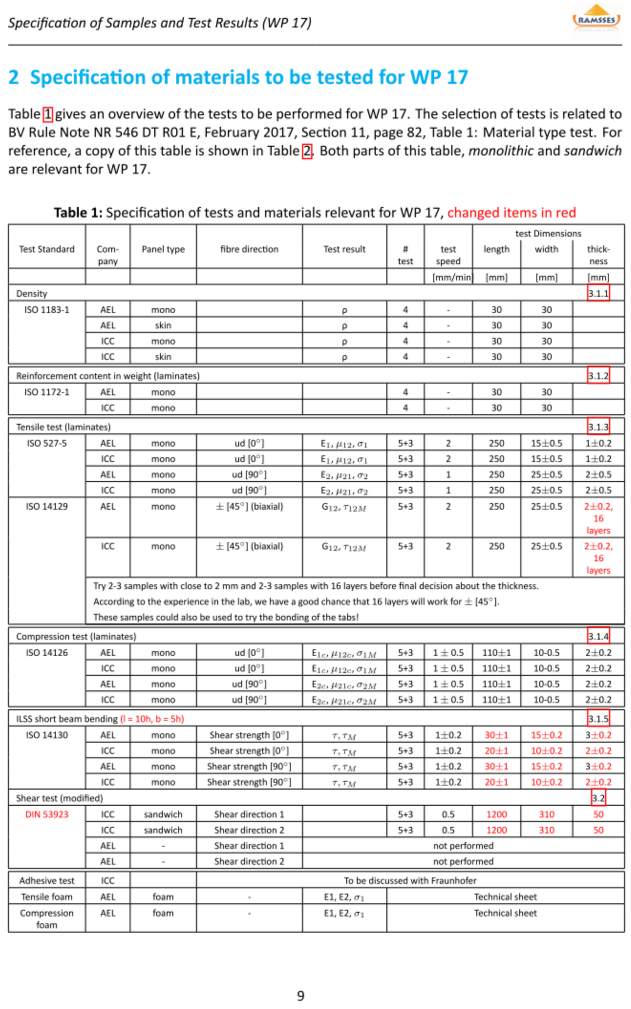
Design Review: Structure, Safety, Stability…

Validation

Mechanical testing

- Density
- Reinforcement content
- Tensile test
- Compression
- 3-point bending
- Large scale box
- Joining technics





Specification of Samples and Test Results (WP 17)

2 Specification of materials to be tested for WP 17

Table 1 gives an overview of the tests to be performed for WP 17. The selection of tests is related to BV Rule Note NR 546 DT R01 E, February 2017, Section 11, page 82, Table 1: Material type test. For reference, a copy of this table is shown in Table 2. Both parts of this table, *monolithic* and *sandwich* are relevant for WP 17.

Table 1: Specification of tests and materials relevant for WP 17, changed items in red

Test Standard	Com-pany	Panel type	fibre direction	Test result	# test	test speed	test Dimensions length	width	thick-ness
						[mm/min]	[mm]	[mm]	[mm]
Density									3.1.1
ISO 1183-1	AEL	mono		ρ	4	-	30	30	
	AEL	skin		ρ	4	-	30	30	
	ICC	mono		ρ	4	-	30	30	
	ICC	skin		ρ	4	-	30	30	
Reinforcement content in weight (laminates)									3.1.2
ISO 1172-1	AEL	mono			4	-	30	30	
	ICC	mono			4	-	30	30	
Tensile test (laminates)									3.1.3
ISO 527-5	AEL	mono	ud [0°]	E_1, μ_{12}, σ_1	5+3	2	250	15±0.5	1±0.2
	ICC	mono	ud [0°]	E_1, μ_{12}, σ_1	5+3	2	250	15±0.5	1±0.2
	AEL	mono	ud [90°]	E_2, μ_{21}, σ_2	5+3	1	250	25±0.5	2±0.5
	ICC	mono	ud [90°]	E_2, μ_{21}, σ_2	5+3	1	250	25±0.5	2±0.5
ISO 14129	AEL	mono	± [45°] (biaxial)	G_{12}, τ_{12M}	5+3	2	250	25±0.5	2±0.2, 16 layers
	ICC	mono	± [45°] (biaxial)	G_{12}, τ_{12M}	5+3	2	250	25±0.5	2±0.2, 16 layers
	Try 2-3 samples with close to 2 mm and 2-3 samples with 16 layers before final decision about the thickness. According to the experience in the lab, we have a good chance that 16 layers will work for ± [45°]. These samples could also be used to try the bonding of the tabs!								
Compression test (laminates)									3.1.4
ISO 14126	AEL	mono	ud [0°]	$E_{1c}, \mu_{12c}, \sigma_{1M}$	5+3	1 ± 0.5	110±1	10-0.5	2±0.2
	ICC	mono	ud [0°]	$E_{1c}, \mu_{12c}, \sigma_{1M}$	5+3	1 ± 0.5	110±1	10-0.5	2±0.2
	AEL	mono	ud [90°]	$E_{2c}, \mu_{21c}, \sigma_{2M}$	5+3	1 ± 0.5	110±1	10-0.5	2±0.2
	ICC	mono	ud [90°]	$E_{2c}, \mu_{21c}, \sigma_{2M}$	5+3	1 ± 0.5	110±1	10-0.5	2±0.2
ILSS short beam bending (l = 10h, b = 5h)									3.1.5
ISO 14130	AEL	mono	Shear strength [0°]	τ, τ_M	5+3	1±0.2	30±1	15±0.2	3±0.2
	ICC	mono	Shear strength [0°]	τ, τ_M	5+3	1±0.2	20±1	10±0.2	2±0.2
	AEL	mono	Shear strength [90°]	τ, τ_M	5+3	1±0.2	30±1	15±0.2	3±0.2
	ICC	mono	Shear strength [90°]	τ, τ_M	5+3	1±0.2	20±1	10±0.2	2±0.2
Shear test (modified)									3.2
DIN 53923	ICC	sandwich	Shear direction 1		5+3	0.5	1200	310	50
	ICC	sandwich	Shear direction 2		5+3	0.5	1200	310	50
	AEL	-	Shear direction 1	not performed					
	AEL	-	Shear direction 2	not performed					
Adhesive test	ICC		To be discussed with Fraunhofer						
Tensile foam	AEL	foam	-	E1, E2, σ_1	Technical sheet				
Compression foam	AEL	foam	-	E1, E2, σ_1	Technical sheet				

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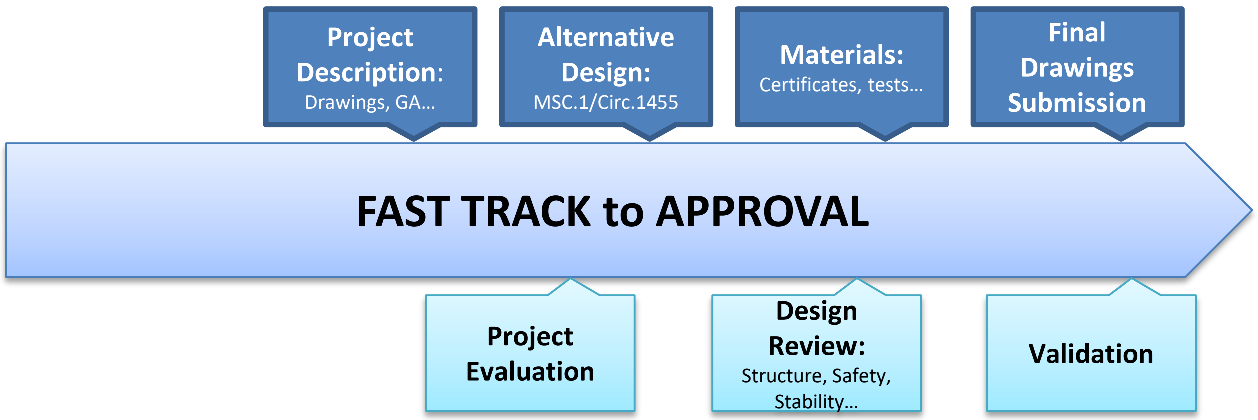
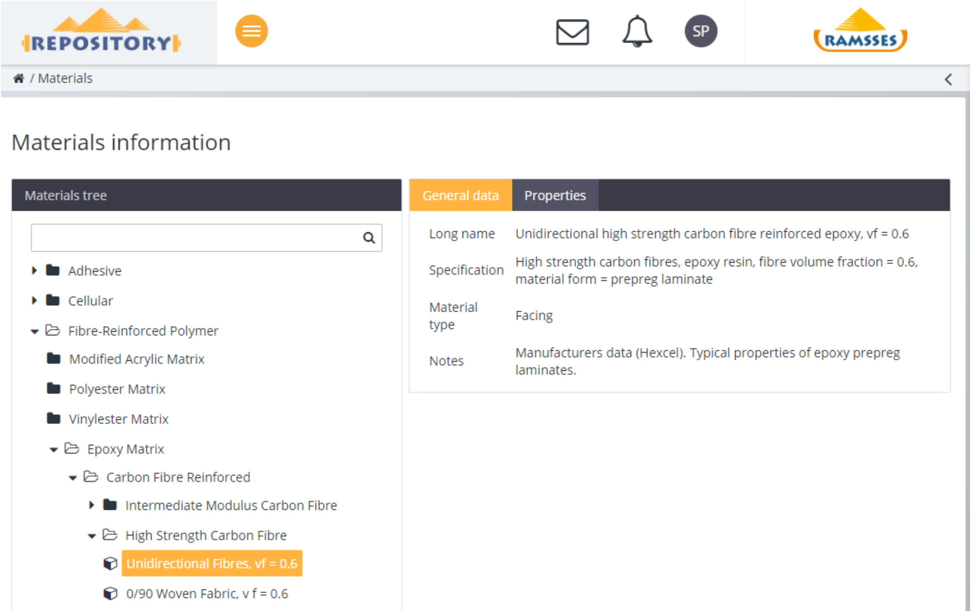
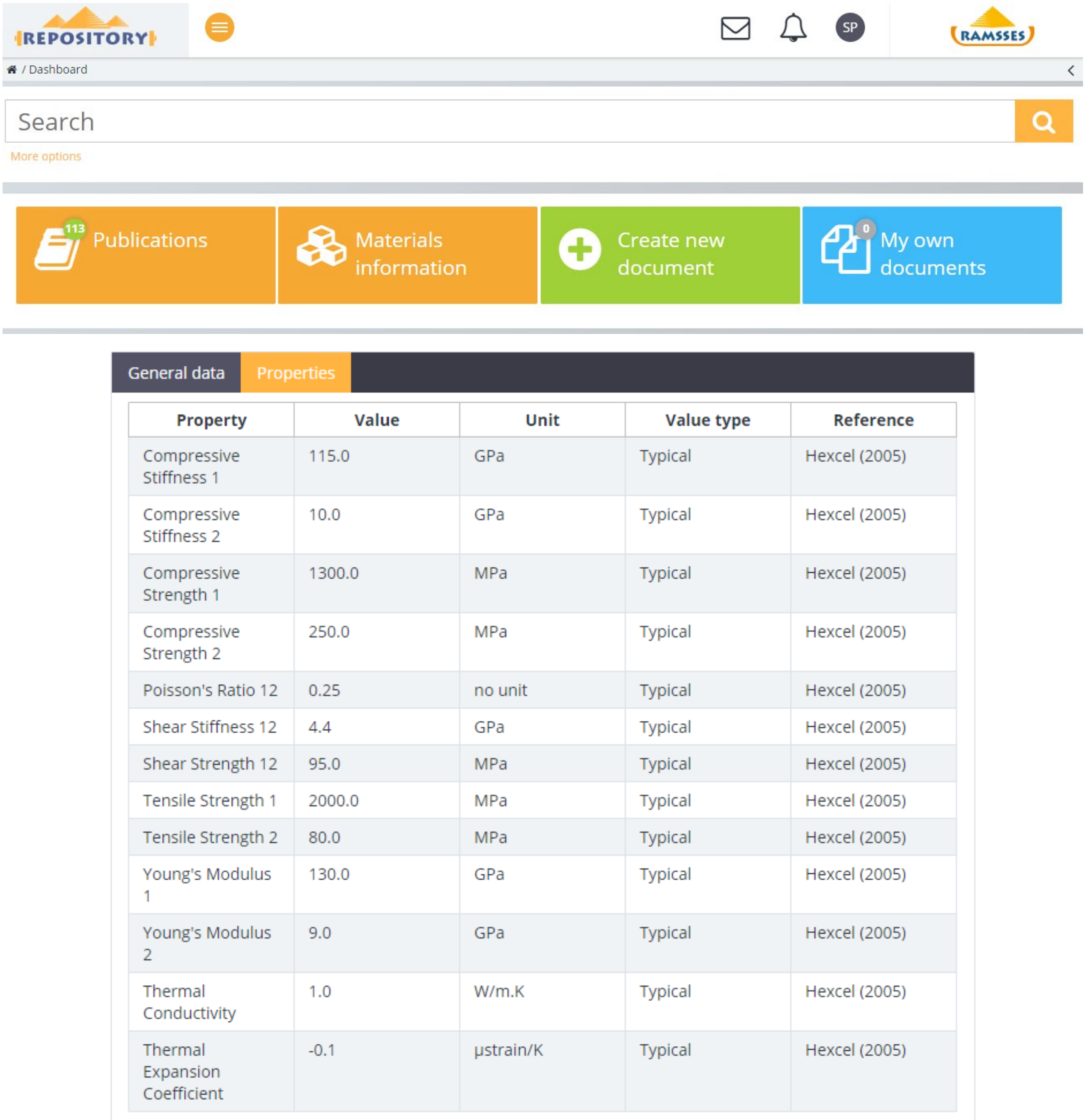
2. FTA – Damen Application Case





https://repository.ramsses.eu/



Property	Value	Unit	Value type	Reference
Compressive Stiffness 1	115.0	GPa	Typical	Hexcel (2005)
Compressive Stiffness 2	10.0	GPa	Typical	Hexcel (2005)
Compressive Strength 1	1300.0	MPa	Typical	Hexcel (2005)
Compressive Strength 2	250.0	MPa	Typical	Hexcel (2005)
Poisson's Ratio 12	0.25	no unit	Typical	Hexcel (2005)
Shear Stiffness 12	4.4	GPa	Typical	Hexcel (2005)
Shear Strength 12	95.0	MPa	Typical	Hexcel (2005)
Tensile Strength 1	2000.0	MPa	Typical	Hexcel (2005)
Tensile Strength 2	80.0	MPa	Typical	Hexcel (2005)
Young's Modulus 1	130.0	GPa	Typical	Hexcel (2005)
Young's Modulus 2	9.0	GPa	Typical	Hexcel (2005)
Thermal Conductivity	1.0	W/m.K	Typical	Hexcel (2005)
Thermal Expansion Coefficient	-0.1	µstrain/K	Typical	Hexcel (2005)

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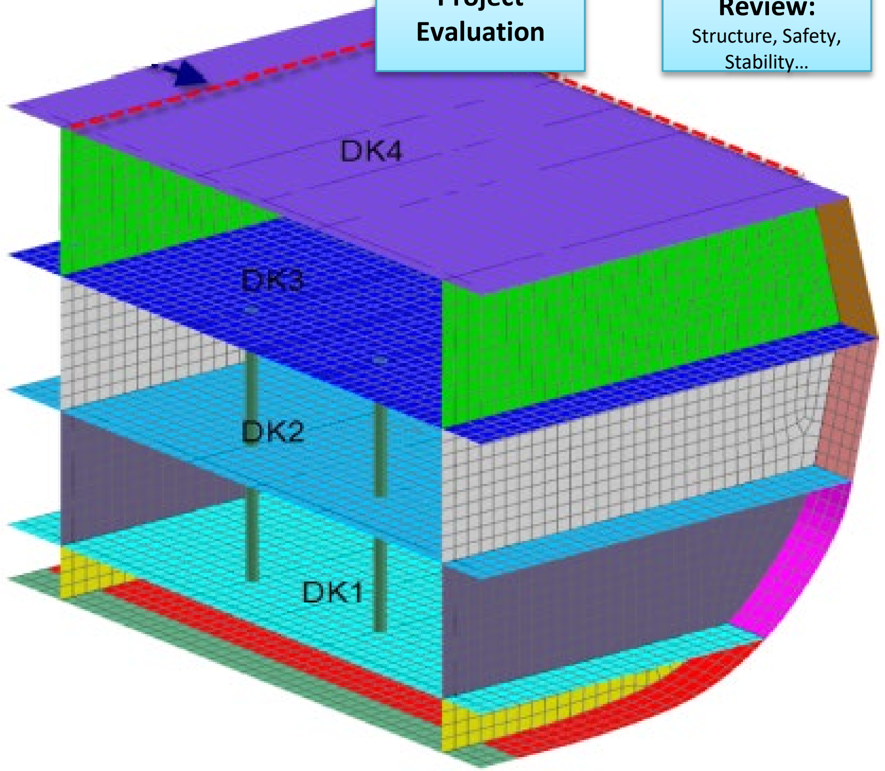
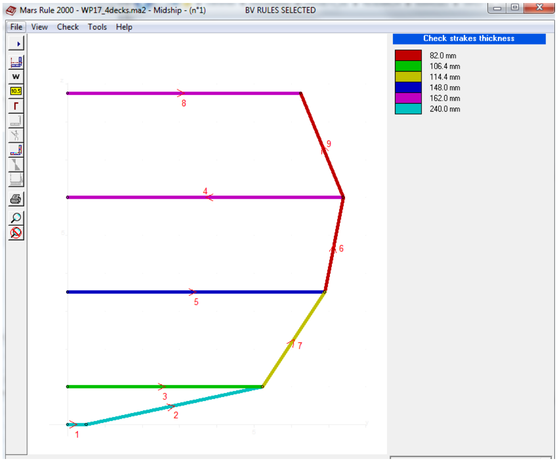
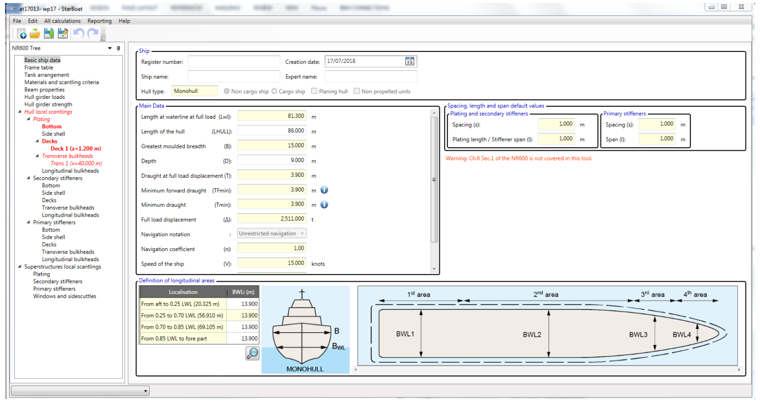


Structure

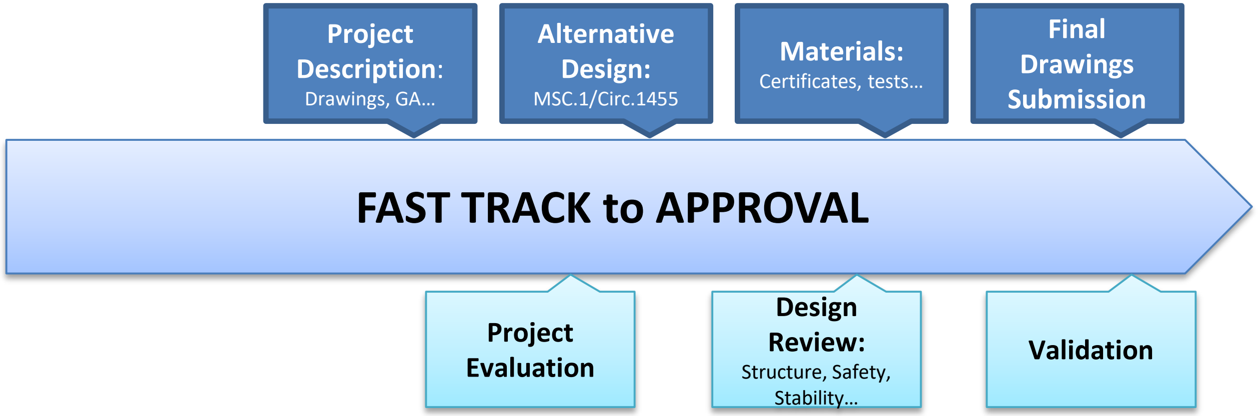
- **MARS**
  - Global scantling



- **StarBoat**
  - Local scantling



- **Finite Element Model**
  - Global and local



Bureau Veritas NR 600 Ch.2-S3.3 (amendment 2018)	Symbol	Laminates
Ageing effect factor	C_V	1.2
Fabrication process [Vacuum Infusion]	C_F	1.15
Tensile or compressive stress // to fibre orientation (for UD)	C_R	2.1
Tensile or compressive stress ⊥ to fibre orientation (for UD)	C_R	1.25
Shear (for UD)	C_R	1.6
ILS (for UD)	C_R	1.6
Buckling	C_{Buck}	1.45
Local static pressure	C_I	1
Dynamic sea pressure (bottom slamming), flooding loads, test loads	C_I	0.8
Impact pressure (side shell impact)	C_I	0.6
Structure under global loads	C_I	1.4
Structure under global and local loads	C_I	0.8

Structure

- **Safety coefficients:**
  - Main stresses: $SF = C_V \cdot C_F \cdot C_R \cdot C_I$
  - Combined stresses: $SFCS = C_{CS} \cdot C_V \cdot C_F \cdot C_I$
  - Buckling stresses: $SFB \geq C_{Buck} \cdot C_F \cdot C_V \cdot C_I$

With:

C_V: the ageing effect

C_F : the composite fabric process and reproducibility of the fabrication

C_R : the type and the direction of the main stresses apply to the fibre of the composite

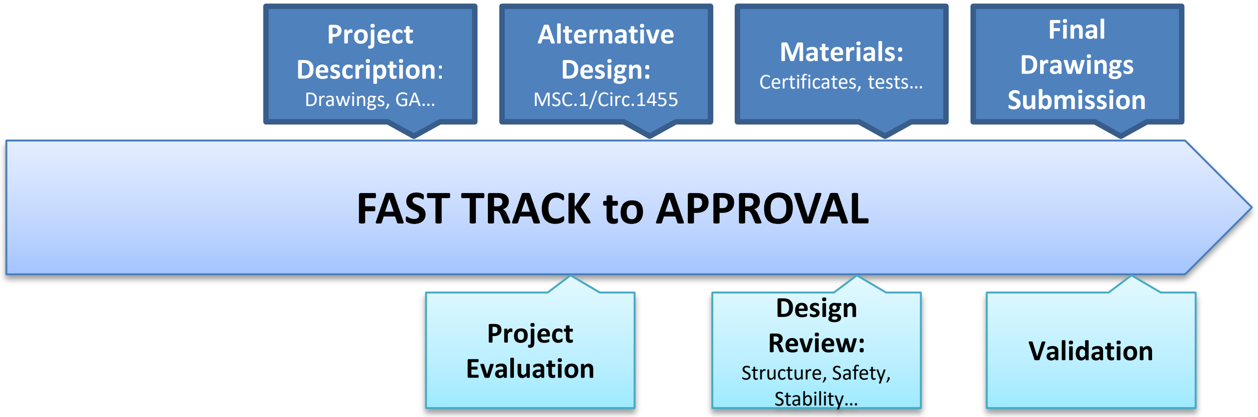
C_I : the type of loads

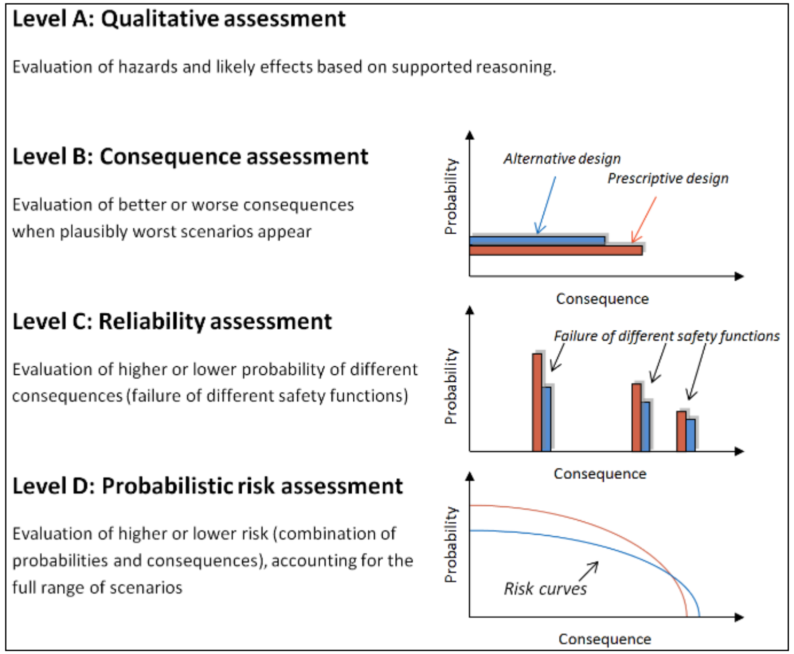
C_{CS} : the combined stress in the layers

C_{Buck} : the buckling factor of the laminate

- **Hull girder flexibility**
  - Fl (theoritical deflection) = $(M L^2 / 10 E I) < 0.3\% L$ (length of the ship)

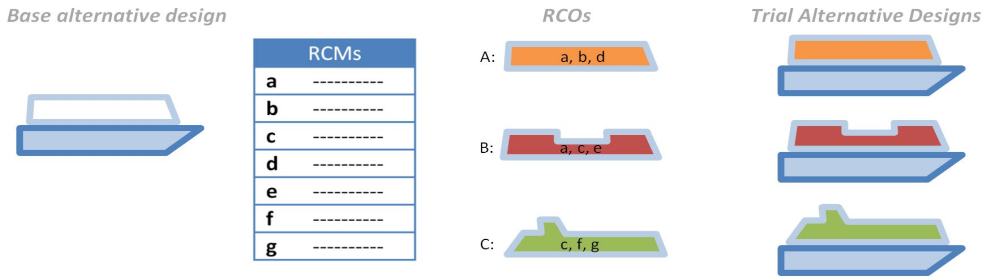
2. FTA – Damen Application Case





Fire

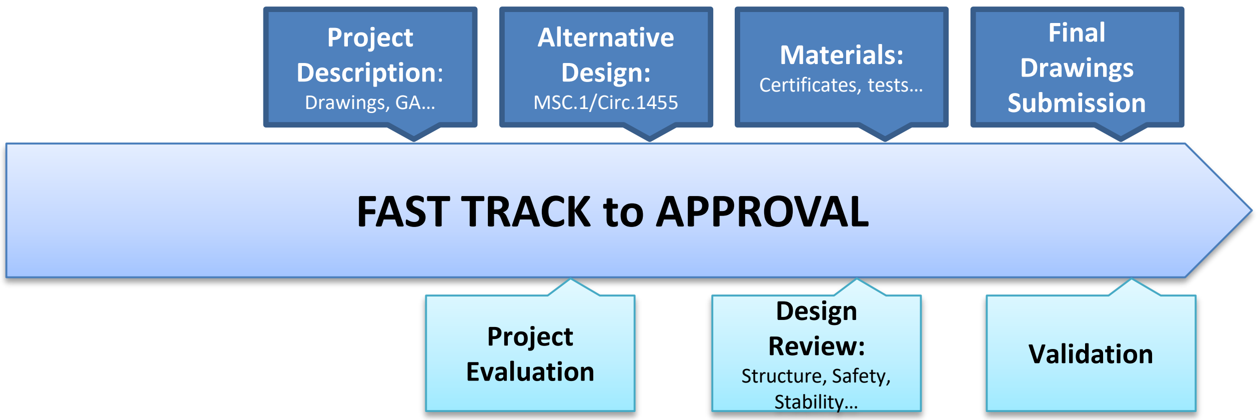
- MSC/Circ. 1002 – Guidelines on alternative design and arrangement for fire safety
- SOLAS - Regulation 17
  - Comparison of a base alternative design and trial alternative design



  - Definition of 4 levels of assessments

- MSC.1/Circ.1574: Interim guidelines for use of Fibre Reinforced Plastic (FRP) Elements within Ship Structures: Fire Safety issues

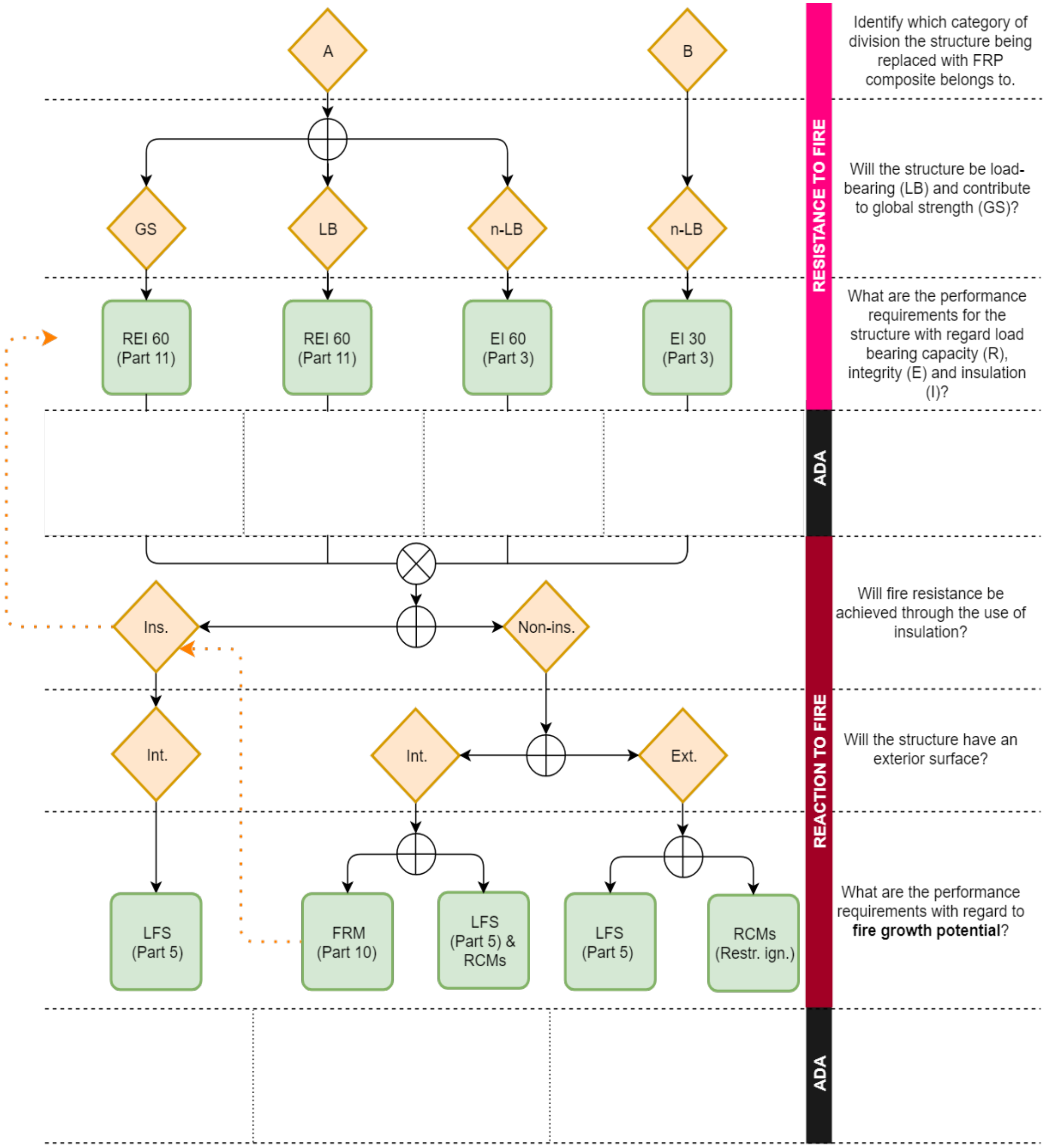
(by defining the FRP element as a structure which may be removed without compromising the safety of the ship)



Fire

- A and B Class Division
- Resistance Class Definition
  - REI or EI
- Insulation / No insulation
  - Low Flame-Spread
  - Fire-Restricting Materials
  - Restricting ignitability

In accordance with FTP Code



2. FTA – Conclusion

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FAST TRACK to APPROVAL

Project Evaluation

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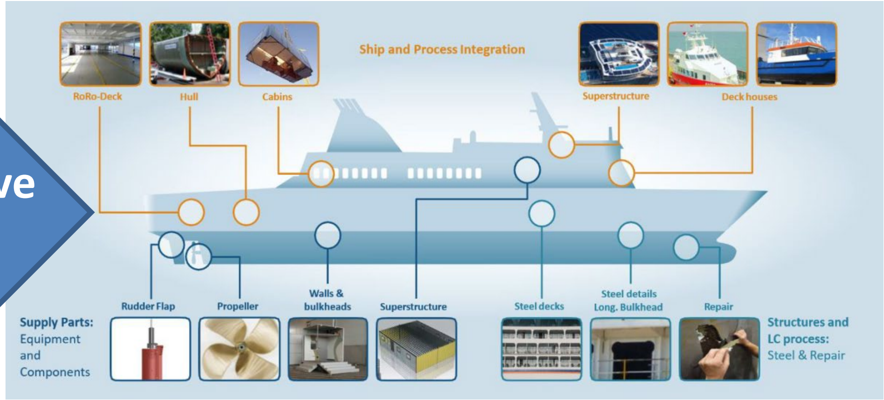
Validation

2 years to achieve this objective



The "Fast Track to Approval" is to be:

- Simple,
- Generic,
- Readable by shipyards, engineering, naval architects, …
- Applicable to all RAMSSES demonstrator cases.

Risk assessment

Introduction of "standard risk scenarios" covering a range of similar applications to limit extensive quantitative risk assessments.

Testing

Database of test results and pre-approved solutions is developed to avoid the necessity of repetitive tests.

Numerical or statistical models that may replace certain physical testing in future.

- PRADS 2019

A "Fast Track to Approval" Process for Innovative Maritime Solutions

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- TRA2020

Proceedings of 8th Transport Research Arena TRA 2020, April 27-30, 2020, Helsinki, Finland

Demonstrating the use of advanced materials and rethinking the innovation process in shipbuilding – Results of the RAMSSES project

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- IMO discussion
  - First meeting, 29th May 2019
  - Lunch presentation, SDC7, London, February 2020

- Qualify and FibreShip projects collaboration
  - Workshop Qualify, RDM, Rotterdam, 18th June 2019
  - Workshop, FibreShip, iXblue, La Ciotat, 25th June 2019

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