



E-LASS#14 DIGITAL EVENT

FIRE SAFETY OF FRP MATERIALS: OUTCOMES FROM R&D PROJECTS

Antoine CASSEZ 17th June 2020



Agenda

 Regulatory framework for fire safety of FRP materials Limitations & barriers AD&A approaches

2. Local approach for fire safety of FRP materials Developments of latest R&D EU Funded Projects

3. A step further Global approach









Limitations & barriers (1/2)

- SOLAS 1974, Chapter II-2, Regulation 2: Fire safety objectives and functional requirements
- Fire safety objectives of SOLAS Chap. II-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 of SOLAS Chap. II-2:
 - 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
 - Detection of any fire in the zone of origin
 - Containment and extinction of any fire in the space of origin
 - Protection of means of escape and access for fire fighting
 - Ready availability of fire-extinguishing appliances
 - Minimization of possibility of ignition of flammable cargo vapour



Limitations & barriers (1/2)

- SOLAS 1974, Chapter II-2, Regulation 2: Fire safety objectives and functional requirements
- Use of FRP materials → impacts and challenges
- Fire safety objectives of SOLAS Chap. II-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 of SOLAS Chap. II-2:
 - 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
 - Detection of any fire in the zone of origin
 - Containment and extinction of any fire in the space of origin
 - Protection of means of escape and access for fire fighting
 - Ready availability of fire-extinguishing appliances
 - Minimization of possibility of ignition of flammable cargo vapour

Limitations & barriers (2/2)

- 1934: Morro Castle passenger ship fire
- SOLAS 1948 introduced the definitions of "A" and "B" class divisions
- "A" and "B" class fire divisions should be constructed of steel or other equivalent materials, or approved noncombustible materials, respectively
- With FRP materials, these requirements cannot be met as they are, unless explicitly demonstrated as per FTP Code, considered as combustible materials









AD&A approaches (1/2)

- SOLAS Chap. II-2, Regulation 17: Alternative design and arrangements
- Gives the possibility to deviate from SOLAS Chap. II-2 requirements, "provided that the design and arrangements meet the fire safety objectives and the functional requirements"
- Decision to go for an Alternative Design
 - Flag: supreme decision
 - Class: normally cannot take the decision alone

- Engineering analysis by Design Team (supplier, fire experts, owner, etc.)
 - Based on:
 - MSC.1/Circ. 1574 (Interim Guidelines for Use of Fibre Reinforced Plastics (FRP) Elements Within Ship Structures: Fire Safety Issues)
 - And complementary to:
 - MSC.1/Circ. 1455 (Guidelines for the Approval of Alternative and Equivalents as Provided for in Various IMO instruments)
 - MSC/Circ. 1002, as amended by MSC.1/Circ. 1552 (Guidelines on Alternative Designs for Fire Safety)









AD&A approaches (2/2)

- MSC.1/Circ. 1574
 - Purpose: ensure consistent approach when approving FRP in AD&A framework
 - Focus on FRP element i.e. structure which may be removed without compromising the safety of the ship, e.g.:
 - Integrated structures

- Components
- In any case, MSC.1/Circ. 1574 does not fully address the risks of progressive structural collapse or global loss of structural integrity due to fire associated with a fully FRP composite ship of FRP composite structures contributing to global strength

- RAMSSES

- Objective: assess the fire safety level of ships built partly or entirely in FRP materials
- Methodology: understand requirements on steel in order to build new requirements for FRP in line with current applicable regulations
- Local approach: deal with fire safety at a local level, i.e. at a space level

Local approach for fire safety of FRP materials

Developments of latest R&D EU Funded Projects (1/5)

- R&D EU Funded Projects:
 - FIBRESHIP





Developments of latest R&D EU Funded Projects (2/5)

- FRP materials: different thermal properties from steel
 - Considered as very good thermal insulator compared to steel
 - Lose their mechanical properties at lower temperature that the insulation criteria of "A" or "B" class fire divisions
- Add insulation for what?
 - Steel: limit the heat conduction
 - FRP: protection against mechanical failure, hence fire propagation + against FRP contribution to combustible materials, hence fire aggravation
- Consequence: "A" or "B" fire rating cannot apply to FRP structures, as expectations behind requirements are different
- However: SOLAS fire safety objectives and functional requirements are still expected for FRP structures









Developments of latest R&D EU Funded Projects (3/5)

- Proposal of new classification of space use for FRP structures (based on space vulnerability in case of emergency and secondly according to their fire risk)
 - 14 categories of space use
 - From Category A to Category N

Space classification	Description							
Α	Control stations							
В	Stairways							
C	Corridors							
D	Evacuation stations and external escape routes							
E	Open decks							
F	Sanitary and similar spaces							
G	Tanks, voids with no or little fire risk							

Space classification	Description								
н	Areas of minor fire risk								
Ι	Areas of moderate fire risk								
J	Areas of high fire risk								
к	Machinery spaces								
L	Auxiliary machinary spaces								
м	Special category and ro-ro spaces								
N	Cargo								



Developments of latest R&D EU Funded Projects (4/5)

- Proposal of new notation for fire resistance of FRP fire divisions
 - R: load bearing capacity
 - E: integrity
 - I: insulation
- Proposal of new structural fire protection times: RE requirements
- FRM, as per FTP Code Part 10
- Any REI division should satisfy FRM requirements in internal spaces
- Spaces in which the risk of fire originating is negligible may be treated separately, through local risk analysis

	Adjacent space →		в	с	D	E	F	G	н	T.	J	к	L	м	N
	Space on fire ↓	^													
	Α	60	60	60	60	30	30	30	30	30	30	60	60	60	60
	В	60	60	60	60	30	30	30	30	30	30	60	60	60	60
	С	60	60	60	60	30	30	30	30	30	30	60	60	60	60
	D	60	60	60	60	30	30	30	30	30	30	60	60	60	60
	E	60	60	60	60	FRM	FRM	FRM	30	30	30	60	60	60	60
	F	60	60	60	60	30	30	30	30	30	30	60	60	60	60
	G	60	60	60	60	FRM	FRM	FRM	FRM	FRM	30	30	30	30	30
	Н	60	60	60	60	FRM	FRM	FRM	FRM	30	30	60	60	60	60
	-	60	60	60	60	FRM	FRM	FRM	30	30	60	60	60	60	60
	J	60	60	60	60	30	30	30	30	60	60	60	60	60	60
	K	60	60	60	60	30	30	30	60	60	60	60	60	60	60
	L	60	60	60	60	30	30	30	60	60	60	60	60	60	60
	Μ	60	60	60	60	30	30	30	60	60	60	60	60	60	60
	N	60	60	60	60	30	30	30	60	60	60	60	60	60	60



Developments of latest R&D EU Funded Projects (5/5)

- REI-180
 - MVZs subdividing hull, superstructure and deckhouses
 - Structures participating to longitudinal strength and floatability of the ship
 - Any loadbearing structure unless appropriate REI class determined via fire risk analysis
- Decks
 - REI-60
 - Lower side: insulation
 - Upper side:
 - FRM if internal deck
 - LFS if external deck





A step further

Global approach (1/1)

- Local approach: minimum fire safety requirements that FRP vessels should meet
- Global approach
 - Fire safety at the ship level
 - Provide the minimum fire safety requirements to ensure the same safety level of a steel ship in case of failure impacting the while vessel due to fire
 - Complementary to local approach
- Consideration of generic risk models
- Consideration of all passive and active systems having an influence on the fire safety of the ship
- Objective: reach at least the risk level for the FRP ship compared to the equivalent steel ship by applying, if necessary, risk control measures







Thank You

Antoine CASSEZ Lead Fire Engineer Energy & Technologies Department antoine.cassez@bureauveritas.com



Move Forward with Confidence