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RAMSSES WP17 FIRE SAFETY





RAMSSES WP17

Full Ship Fire Safety Analysis



RAMSSES WP17 CASE STUDY

Content

- Case Study Vessel & Project
- Approach for SOLAS approval (Reg. 17)
- Helicopter fire safety
- BV closing statement





RAMSSES WP17 CASE STUDY

Scaling up composites

- 1. **Requirements** for 85 meters hull set by Damen Naval & DSGo
- 2. **Design** performed by DSGo & evaluated by Bureau Veritas
- 3. Novel resin developed by Evonik
- 4. Infusion process developed by Airborne and Infracore
- 5. 6 meter hull shell infused by Airborne,
- 6. 6 meter vertical infusion achieved by Infracore
- 7. Joints developed by Infracore and to be tested by TNO
- 8. Fire Safety with Damen Naval, NMTF, Bureau Veritas and Rise
- 9. Validation testing defined by TNO 8 meter long box
- **10. Test** setup and assembly rig produced by Damen Naval
- 11. Assembly being prepared by Infracore and Damen Naval



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DAMEN SHIPYARDS GORINCHEM

nnovation or life

InfraCoreinsid

Airborne





RAMSSES WP17 CASE STUDY

RAMSSES WP17 CASE

- 85 Meter Offshore vessel with less than 60 crewmembers (SP60)
- Unrestricted sailing
- SOLAS Ch.II-2 Reg.17 & MSC.1/Circ1455
- Alternative design
 - Supported by RISE
 - Monitored by Bureau Veritas & NMTF

		Greater than	Between	Less than	500 GT
		1000 GT	500 and 1000 GT	Unrestricted navigation	Restricted navigation
Steel or aluminium material	N ≤ 60	Part C, Chapter 4Ch 16, Sec 5	• NR566	• NR566	• NR566
	N >60 (1)	Part C, Chapter 4Ch 16, Sec 5	Part C, Chapter 4Ch 16, Sec 5	Part C, Chapter 4Ch 16, Sec 5	NR566Ch 16, Sec 5
Composite material	N ≤ 60	NA (2)	 NR566 	• NR566	• NR566
	N >60 (1)	NA (2)	NA (2)	NA (2)	NR566Ch 16, Sec 5



I № HULL № MACH, Offshore Patrol Vessel – OPV, Unrestricted № AUT-UMS № SP 60



Approach for WP 17

- IMO HSC CODE
 - Allows composites
 - Compartment based insulation
 - Assumes small ship
 - Assumes fast rescue
- SOLAS
 - Large ocean-going ships
 - Assumes metal structures
 - Division based insulation

- Compartment and risk-based insulation
- Fire zoning for Unassisted evacuation







Risk based insulation

- Inspired by ANEP 77- Solution 2
- Table proposed and agreed upon by design team
- Consequence
 - Evacuation
 - Ship survival
- Probability
 - Time based
 - Fire curve vs active measures

RE	I (Oth	ner	R	EI	Consequence				
	side)		(ins	ide)	1 2 3 4				
	1	/		1	/	15	15	30	30
ence	2	/	iltiy	2	15	15	30	30	60
nbəs	3	/	bab	3	15	30	30	60	60
Cons	4	30	Pro	4	30	30	60	60	60
	5	60		5	30	60	60	60	60

Risk based insulation

- Inspired by ANEP 77- Solution 2
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AVERAGE F	PERSON	
area (ft ²)	area (m ²)	P[fail]
60	5.57	96.702
50	4.64	79.360
40	3.72	54.740
30	2.79	18.461
20	1.86	9.046
15	1.39	3.84
10	0.93	2.08
5	0.46	1.55

TRAINED F	TRAINED FIRE BRIGADE								
area (ft ²)	area (m²)	P[fail]							
400	37.16	99.894							
200	18.58	90.204							
100	9.29	30.646							
60	5.57	1.149							
40	3.72	0.267							
20	1.86	0.14							
10	0.93	0.11							



Risk based insulation

	1	2	3	4	5	6	7	8	9	10	15	
Passive protection 60 min							Т	ïme to insula	ation failure			
Passive protection 30 min						Time	e to insulati	on failure				
Passive protection 15 min					Time to insu	lation failure						Bulging
FIFI 1	Time to FIF	l activation						FIFI Activa	tion			
Firefighting	Alarm and	Time to f	irst attack	First attack				Extornal o		ontry PA cr		
crew present	first aid	Firefight	ting crew	FIRST ATTACK				External o	mensive + re	entry ba ci	ew	
Success rate	98%			73%					96%			
Firefighting			Time to f	irst attack								
no crew present;		Alarm Firefighting crew 73%				First attack External offensive + re-entry BA crev				y BA crew		
automatic detection succesfull			ritetigii	ting crew								
Success rate					37,50%	75%						
Firefighting												
no crew present in						Timo to fi	ret attack					
compartment;					Alarm	Firefight		First attack		External o	offensive + re	-entry BA
automatic detection fails. Crew						rnengnt	ingciew					
detect fire from corridor												

DAMEN

Fire Zoning

• Provide a safe platform for at least 3 hours

Environment Conditions "

Service	Operation	hai .	5.5°2	Survival	200	Damage	101	0.00	
Class	Wind Speed		Sig.	Wind Spe	Wind Speed		Wind Speed		Sig.
	Nominal (B'fort)	Design (knots)	Wave Height (m)	Nominal (B'fort)	Design (knots)	Wave Height (m)	Nominal (knots)	Design (knots)	Wave Height (m)
Ocean Unlimited	9	70	6.0	12	100	17.7	26	39	25
Limited	8	-60	6.0	10	80	112	20	39	25
Offshore	7	50	4.0		60	6.2	24	36	22
Restricted	6	40	2.5	7	50	4.3	22	33	1.8
Protected Waters	5	30	1.25	6	40	2.5	20	30	1.5
Smooth Waters	5	30	0.5	6	40	0.8	20	30	0.5



DAME

Equivalency criteria

APPROACH FOR SOLAS APPROVAL-CRITERIA

Equivalency criteria

- Qualitative assessment
- Quantitative assessment
 - Risk analysis

$$PLL_{Alt} \le PLL_{Presc}$$

$$\varphi_{1Alt} \le \min\left(\varphi_{1Presc}; k \times \frac{PLL_{Presc}}{\sum_{n=1}^{Nmax} 1/n}\right)$$

- Unassisted evacuation
 - Safe platform for at least 3 hours at sea







HELIDECK FIRE SAFETY

WP 17 demonstrator



Fire safety analysis on demonstrator

Helicopter crash

Possible risks

- Exposed core
- Convex helideck
- Ignition of the superstructure
- Flame spread on helideck (anti-skid)
- Toxic fumes







HELICOPTER FIRE SAFETY

Test 1: Helicopter crash

Multiple impact tests surpassing helicopter emergency landing loads are demonstrated on the RAMSSES hull shell and its composite helicopter deck.

- 1500 kg, 1, 5 m falling height
- Multiple hits on deck and hull
- No significant damage
- No penetration of skin





HELICOPTER FIRE SAFETY

Test 2: Fire Tests

- Steel reference + Bolidt B2
- Composite Panel + Bolidt B3 + Damage
- Stack of 15 EuroPallets as fire source











Test 2: Fire Tests





Surpassing one hours fire duration. Representative for helideck fire. Easy extinguishable after one hour duration. Thank you all involved!



HELICOPTER FIRE SAFETY

Test 2: Fire Tests

- Increase in smoke production from the FRP
- No substantial difference regarding flame spread
- Unexposed side composite at room temperature
- Irradiance not likely to ignite superstructure
- No bulging expected











WP17 FIRE SAFETY

Conclusions



- Full composite ship fire safety
- Comprehensive method for fire safety for full composite ship
- Local and global analysis
- Combining active and passive methods
- Time based approach
- Fire scenario on Ramsses Demonstrator



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Thank you for your attention