



UNIVERSIDADE DA CORUÑA



Escola Politécnica Superior

Trabajo Fin de Grado
CURSO 2016/17

17-07 FERRY 1500 PAX Y 1000 ML

CUADERNO 3

DISEÑO DE FORMAS

Grado Ingeniería Naval y Oceánica

ALUMNO

Marcos Covelo Fernández

TUTOR

Fernando Lago Rodríguez

FECHA

2017



Escola Politécnica Superior

UNIVERSIDADE DA CORUÑA

GRADO EN INGENIERÍA NAVAL Y OCEÁNICA
TRABAJO FIN DE GRADO

CURSO 2.016-2017

PROYECTO NÚMERO 17-07

TIPO DE BUQUE: RO-PAX

CLASIFICACIÓN, COTA Y REGLAMENTOS DE APLICACIÓN: DNV GL, Marpol, Solas. SRTP.

CARACTERÍSTICAS DE LA CARGA: 1500 pasajeros, 1000 metros lineales que permitirán transportar 30 tráileres y 115 turismos simultáneamente.

VELOCIDAD Y AUTONOMÍA: 26 nudos al 90% MCR, 15% de margen de mar, autonomía de 3000 millas.

SISTEMAS Y EQUIPOS DE CARGA / DESCARGA: los propios de este tipo de buque.

PROPULSIÓN: Dual-fuel (diésel/GNL).

TRIPULACIÓN Y PASAJE: 1500 pasajeros y 55 tripulantes.

OTROS EQUIPOS E INSTALACIONES: los propios de este tipo de buque.

Ferrol, 28 Setiembre 2016

ALUMNO: **D. Marcos Covelo Fernández**



ÍNDICE:

1. Introducción.....	pág-4
2. Coeficientes.....	pág-7
3. Contornos de proa.....	pág-8
4. Contornos de popa.....	pág-12
5. Diseño de formas.....	pág-13
6. Comprobación bulbo y codaste.....	pág-15
7. Cálculo de hidrostáticas al calado de diseño y curva de áreas.....	pág-17
Planos.....	pág-19
Anexo.....	pág-24



1. Introducción:

En este proyecto se diseña un buque tipo Ro-Pax. Dicho buque será diseñado con objeto de transportar 1500 pasajeros y 1000 metros lineales de carga rodada, que le permitan albergar 115 turismos y 30 tráileres simultáneamente. Estará destinado para trayectos relativamente largos, por lo que contará con acomodación adecuada para viajes nocturnos (todos los pasajeros dispondrán de camarotes o cómodas butacas) y de diversos servicios a bordo (restaurante, cafeterías, tiendas, zonas de ocio). Será dotado con propulsión dual-fuel en línea con las actuales exigencias medioambientales. El diseño se realizará de acuerdo a la Sociedad de clasificación DNV-GL y será conforme con Marpol y Solas (incluyendo el requerimiento de retorno seguro a puerto SRTP). La velocidad de servicio que deberá alcanzar será de 26 Kn con una autonomía de 3000 millas.

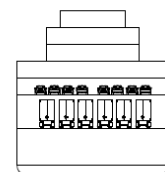
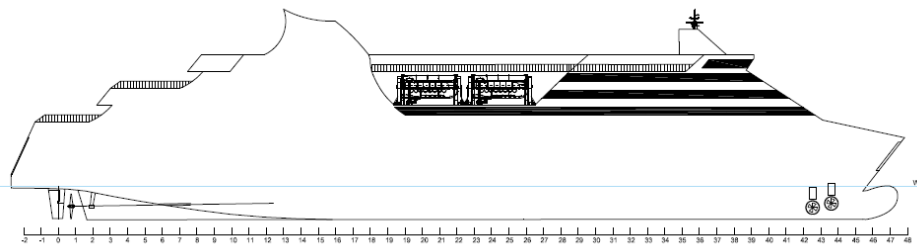
Neste proxecto diseñase un buque tipo Ro-Pax. Este buque estará deseñado para transportar 1500 pasaxeiros e 1000 metros lineais de carga rodada, o que lle permite acomodar 115 vehículos e 30 tráileres simultaneamente. Estará destinado a viaxes relativamente longas, polo que terá aloxamento adecuado para viaxes nocturnas (todos os pasaxeiros terán cabinas ou cómodos asentos) e varios servizos a bordo (restaurante, cafeterías, tendas, áreas de lecer). Estará equipado con propulsión de dobre combustible en liña cos requisitos ambientais actuais. O deseño realizarase segundo a sociedade de clasificación DNV-GL e estará de acordo con Marpol e Solas (incluído o requisito de retorno seguro a porto SRTP). A velocidade de servizo a alcanzar será de 26 Kn cunha autonomía de 3000 millas.

In this project a ship type Ro-Pax is designed. This vessel will be designed to carry 1500 passengers and 1000 linear meters of roll cargo, allowing it to accommodate 115 cars and 30 trailers simultaneously. It will be destined for long journeys, so it will have adequate accommodation for night trips (all passengers will have cabins or comfortable seats) and various services on board (restaurant, coffee shops, shops, leisure areas). It will be equipped with dual-fuel propulsion in line with current environmental requirements. The design will be made according to the DNV-GL classification society and will be in accordance with Marpol and Solas (including the safe return to port SRTP). The service speed to be achieved will be 26 knots with an autonomy of 3000 miles.



Características buque Ferry

L_{pp}	130 m
L_{total}	145,6 m
B	24,4 m
D	7,84 m
$T_{diseño}$	5,26 m
C_b	0,58
C_m	0,960
C_p	0,60
Despl	9923,2 t
Pasajeros	1500
Tripulación	55
Velocidad	26 nudos
BKw	31768,6 Kw





En el presente cuaderno se determinarán las formas del buque del proyecto, que se adecuen al desplazamiento hallado y tomando como referencia los coeficientes obtenidos.

Las formas con las que se dote al buque deben:

- Permitir albergar la carga.
- Reducir la resistencia al avance del buque.
- Aportar la estabilidad necesaria.

Para la realización de las formas se utilizaron los siguientes programas informáticos:

- Maxsurf v20: conjunto de herramientas para la modelización y optimización de diseños de buques.
- Autocad: software de diseño asistido por computadora utilizado para dibujo 2D y modelado 3D.
- Navcad: programa de predicción y análisis de velocidad y potencia para buques.



2. COEFICIENTES:

Los coeficientes adimensionales del buque mostrados en la tabla fueron calculados en el cuaderno 1. A continuación se muestra un resumen de como se obtuvieron:

- **Coeficiente de bloque:**

Obtenido de la selección de alternativas, siendo el que minimizaba los costes del astillero.

$$C_b = 0,58$$

- **Coeficiente de la maestra:**

Se usó la fórmula de Schneekluth y Murray que relaciona el C_m con el número de Froude:

$$C_m = 1 - 2 \cdot Fn^4$$

para Fn entre 0 y 0,5.

$$C_m = 0,96$$

- **Coeficiente prismático:**

El cálculo del C_p se realizó mediante su dependencia con los otros dos coeficientes:

$$C_p = C_b / C_m$$

$$C_p = 0,603$$



3. CONTORNOS DE PROA:

El diseño del contorno de proa dependerá principalmente de si se opta por dotar a la carena de bulbo o no. La decisión sobre la utilización o no del bulbo de proa se hace por consideración de mejoras propulsivas en las distintas situaciones de carga, aunque no se debe olvidar otros aspectos como la posible mejora de comportamiento en la mar, (reducción de pantocazos, potencia requerida con olas, etc.) y el incremento de coste estructural.

Un bulbo apropiado, en lo relativo a la propulsión, actúa de la siguiente forma:

- Reduce la resistencia por formación de olas, al disminuir el tren de olas generado por el buque.
- Reduce la resistencia por olas rompientes, al conseguir menos olas y más amortiguadas.
- Reduce la resistencia residual de carácter viscoso al disminuir los torbellinos de proa.
- Aumenta la resistencia friccional por aumentar la superficie mojada.

Para determinar la necesidad o no del bulbo en el buque de proyecto se comprobó si este entraba en los márgenes citados en el libro "Proyecto de las formas de un buque" de F. Junco:

$$0,65 < C_b < 0,815$$

$$5,50 < L/B < 7$$

$$0,24 < F_n < 0,57$$

$$C_b \cdot B / L_{pp} < 0,135$$

Los valores obtenidos fueron:

- | | |
|----------------------------------|-----------|
| - $C_b = 0,58$ | No cumple |
| - $L_{pp} / B = 5,32$ | No cumple |
| - $F_n = 0,374$ | Cumple |
| - $C_b \cdot B / L_{pp} = 0,108$ | Cumple |

Se obtuvo que dos criterios cumplen y otros dos no, aunque se encuentran cerca de los márgenes de aceptación. Por otra parte, se ha tenido en consideración que todos los buques de la base de datos tienen bulbo, y que este favorece el comportamiento del barco en el mar. Esto último tiene un mayor efecto con mala mar, condición a la que se verá sometido el buque en su utilización, y que tiene gran importancia dado que transportará pasajeros.



Por todo ello, se decidió introducir el bulbo de proa.

Los parámetros obtenidos para caracterizar el bulbo fueron la altura, protuberancia y área transversal.

- Área transversal:

Dado que el buque de proyecto opera en servicio a un número de Froude de:

$$Fn = 0,374$$

El cual es un valor de Fn relativamente elevado, el cálculo del área transversal se realizó mediante la gráfica 8.3.6. del citado libro "Proyecto de las formas de un buque" de F. Junco. Donde entrando con el valor de Fn se obtiene el área del bulbo en función del área de la maestra (S_b):

$$S_b = 0,12$$

$$\text{Área bulbo} = 14,8 \text{ m}^2$$

- Protuberancia:

Se obtuvo a partir de un buque base, según la fórmula del libro "Proyecto de las formas de un buque" de F. Junco:

$$100 \cdot X' = 100 \cdot X + K_1 (Cb' - Cb) - K_2 \cdot (L'/B' - L/B)$$

Donde:

- Los valores con prima pertenecen al nuevo proyecto y los que no al buque base.
- $K_1 = 8$
- $K_2 = 0,4$

Como buque base se tomó el Volcán de Tinamar, dado que es el buque de la base de datos que navega a una velocidad más cercana a la del proyecto y también opera a Fn elevados.

El resultado obtenido:

$$X' = \text{Protuberancia} = 7,88 \text{ m}$$

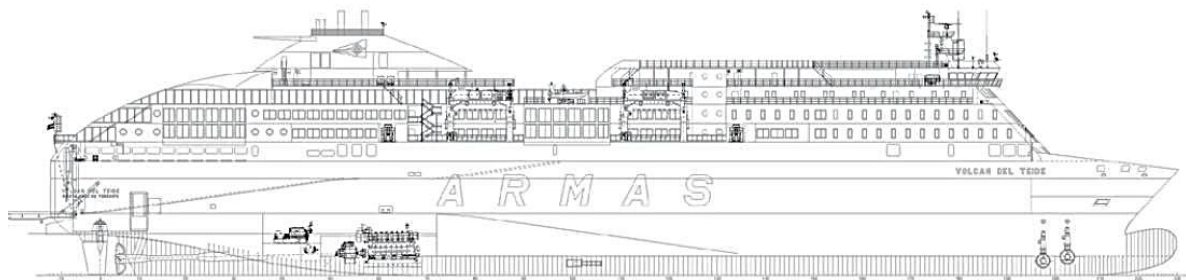


- Altura:

Se tomó a partir de las medidas realizadas en el buque base (Volcán de Tinamar) y de las recomendaciones del citado libro. Se consideró adecuado un valor de:

$$h = 0,8 \cdot T_{pr}$$

$$h = 0,8 \cdot 5,25 = 4,2 \text{ m}$$



3.1- Perfil del buque Volcán de Tinamar.

Una vez calculado el bulbo, se ha optado por comprobar que cumple con su función de disminuir la resistencia del casco. Para ello se utilizó el software Navcad, donde se obtuvieron los valores de resistencia de la carena con y sin el bulbo, para la condición de servicio.

Hull		
Configuration:	Monohull	
Chine type:	Round/multiple	
General		
Length on WL:	130,000	m
Max beam on WL:	24,400	m
Max molded draft:	5,260	m
Displacement:	9923,20	t
Wetted surface:	3114,0	m ²
Demi-hull spacing:		m
ITTC-78 (CT)		
LCB fwd TR:	62,400	m
LCF fwd TR:	62,400	m
Max section area:	123,2	m ²
Waterplane area:	2218,3	m ²
Bulb section area:	0,0	m ²
Bulb ctr below WL:	0,000	m
Bulb nose fwd TR:	0,000	m
Imm transom area:	0,0	m ²
Transom beam WL:	0,000	m
Transom immersion:	0,000	m
Half entrance angle:	7,00	deg
Bow shape factor:	-1,0	[BTK flow]
Stern shape factor:	1,0	[WL flow]

Hull		
Configuration:	Monohull	
Chine type:	Round/multiple	
General		
Length on WL:	130,000	m
Max beam on WL:	24,400	m
Max molded draft:	5,260	m
Displacement:	9923,20	t
Wetted surface:	3114,0	m ²
Demi-hull spacing:		m
ITTC-78 (CT)		
LCB fwd TR:	62,400	m
LCF fwd TR:	62,400	m
Max section area:	123,2	m ²
Waterplane area:	2218,3	m ²
Bulb section area:	7,0	m ²
Bulb ctr below WL:	3,000	m
Bulb nose fwd TR:	135,300	m
Imm transom area:	0,0	m ²
Transom beam WL:	0,000	m
Transom immersion:	0,000	m
Half entrance angle:	7,00	deg
Bow shape factor:	-1,0	[BTK flow]
Stern shape factor:	1,0	[WL flow]



Los valores obtenidos fueron:

- Para la carena **sin bulbo = 1689,33 Kn**
- Para la carena **con bulbo = 1469,2 Kn**

A la vista de los resultados obtenidos, parece justificada la decisión de introducir el bulbo en el proyecto.



4. CONTORNOS DE POPA:

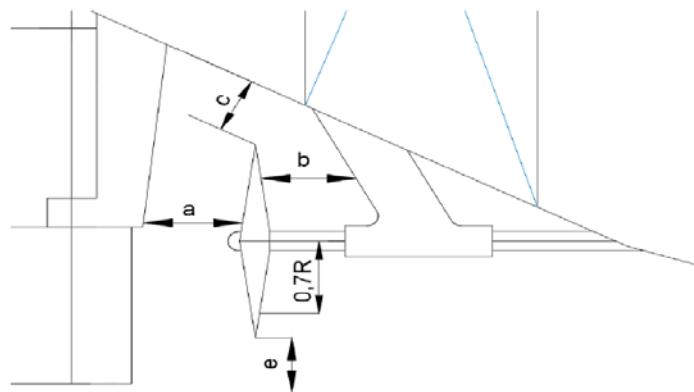
El contorno de popa influye de forma importante en el flujo de entrada de agua a las hélices, pudiendo causar un mal rendimiento de estas si no se diseña de forma correcta.

Dado que es un buque con dos hélices, las estelas reflejadas estarán menos influenciadas por las formas del buque, a pesar de esta ventaja, es necesario tener en cuenta:

- La buena interacción de la hélice con el timón, para asegurar una estabilidad satisfactoria.
- Se han de evitar a toda costa problemas de vibraciones debido a isoestelas en forma de V, por lo que es necesario un espacio adecuado para las hélices.
- Las formas de popa han de asegurar un desprendimiento de capa límite mínimo, para evitar mayor resistencia.
- Economía en la construcción.

Se deben determinar, por tanto, las claras de la hélice-carena evitando los problemas de cavitación, vibraciones y resistencia que se producirían si estos huelgos fueran insuficientes. Para ello se tendrán en cuenta las recomendaciones de la Sociedad de Clasificación correspondiente (DNV-GL).

- $a \geq 0,2R(m) = \mathbf{0,4\ m}$
- $b \geq (0,7-0,04 Z_p)R(m) = \mathbf{1\ m}$
- $c \geq (0,48-0,02Z_p)R(m) = \mathbf{0,76\ m}$
- $e \geq (0,07)R(m) = \mathbf{0,14\ m}$



4.1- Identificación de los huelgos en el codaste.



5. DISEÑO DE FORMAS:

Para el diseño de las formas del buque proyecto se utilizó el método de la transformación paramétrica, obteniendo una carena válida a partir de otra ya existente.

Dicho proceso de transformación paramétrica consiste en modificar las dimensiones de una carena ya existente para adaptarla a los valores del buque proyecto. Este se realizó con el software Maxsurf V20.

Como carena de partida se tomó del proyecto de la E.P.S. N° 14-105 “Ro-Ro 1000 pax” de María de la Luz Muras Casas. Se trata de las formas de un buque tipo ro-pax. Se seleccionó esta carena de partida por:

- Se trata de un barco de características similares en cuanto a uso.
- Cuenta con bulbo de proa, al igual que el del proyecto.
- Cuenta con popa de estampa, adecuada para el proyecto de un ferry.
- La popa está pensada para albergar dos hélices propulsoras, tal y como se definió en el buque proyecto.

Se muestra a continuación las correspondientes hidrostáticas de la carena que se usó como partida:

Displacement	17176	t
Volume (displaced)	16759,315	m ³
Draft Amidships	6,090	m
Immersed depth	6,090	m
WL Length	181,088	m
Beam max extents on WL	28,205	m
Wetted Area	5166,095	m ²
Max sect. area	168,710	m ²
Waterpl. Area	4101,237	m ²
Prismatic coeff. (Cp)	0,549	
Block coeff. (Cb)	0,539	
Max Sect. area coeff. (Cm)	0,982	
Waterpl. area coeff. (Cwp)	0,803	
LCB length	77,886	from zero pt. (+ve fwd) m
LCF length	67,890	from zero pt. (+ve fwd) m
LCB %	43,010	from zero pt. (+ve fwd) % Lwl
LCF %	37,490	from zero pt. (+ve fwd) % Lwl
KB	3,508	m
KG fluid	0,000	m
BMt	14,529	m
BML	470,599	m



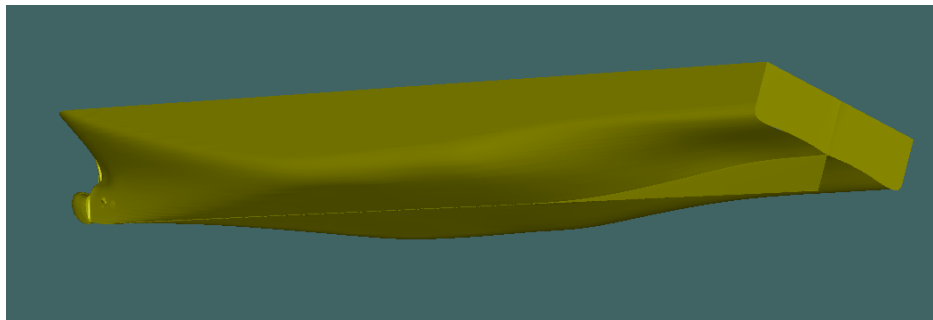
GMt corrected	18,037	m
GML	474,107	m
KMt	18,037	m
KML	474,107	m
Immersion (TPc)	42,038	tonne/cm
MTc	487,023	tonne.m
RM at 1deg = GMt.Disp.sin(1)	5407,494	tonne.m
Length:Beam ratio	6,421	
Beam:Draft ratio	4,631	
Length:Vol^{0.333} ratio	7,067	

Los planos correspondientes se muestran en la sección de planos.

Se observa que se trata de un buque de mayores dimensiones que el del proyecto. Se adaptó a los datos de nuestro buque y se ajustaron los diferentes detalles constructivos propios de este:

- Se adaptó el bulbo de proa al calculado
- Se introdujeron los espacios para los bow thrusters.
- Se comprobó la validez de las formas de popa

La cartilla de trazado correspondiente se muestra en el anexo, y en la sección de planos se adjuntan los planos de formas.

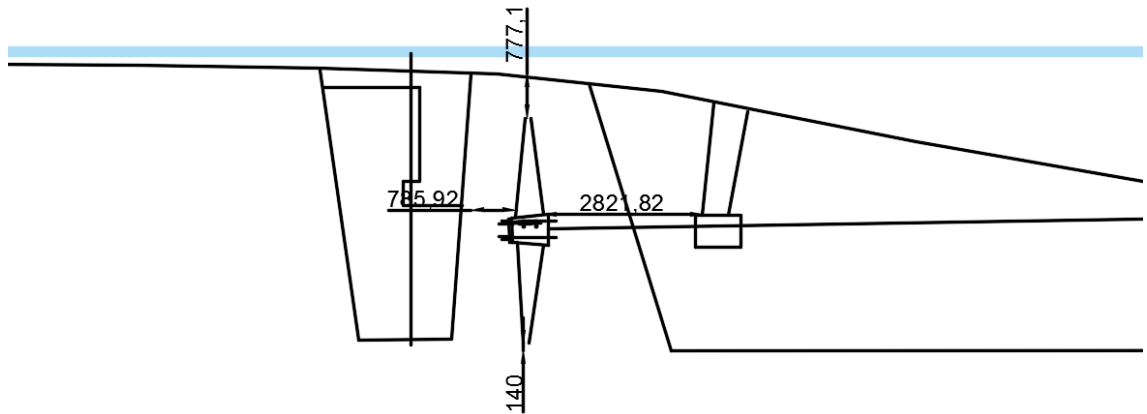


5.1.1-Imagen 3D de la carena obtenida.

6. Comprobación bulbo y codaste:

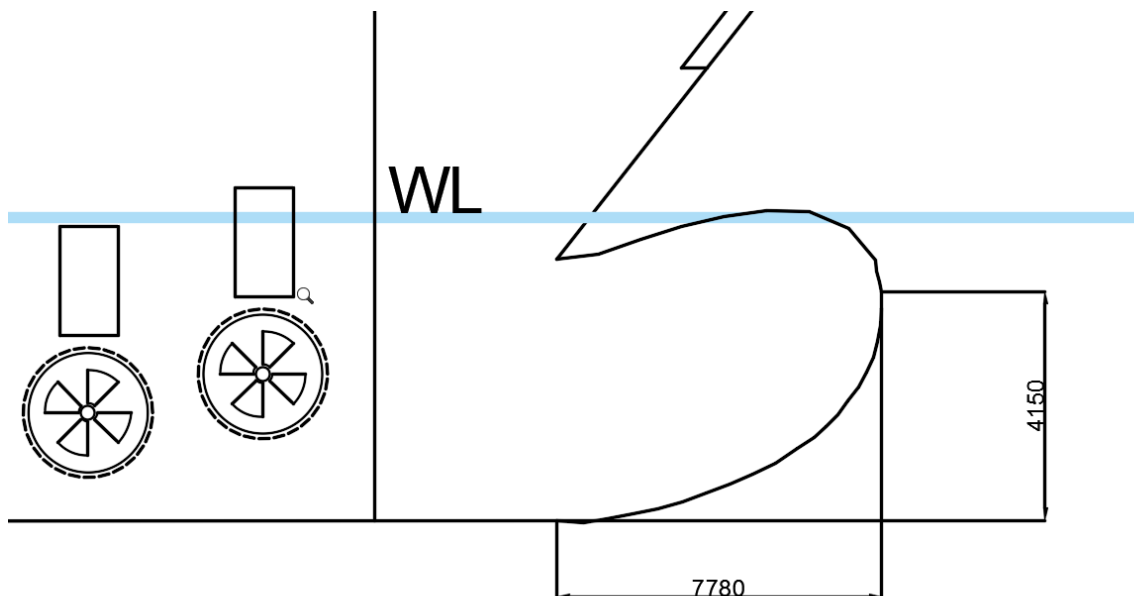
Se realizaron las comprobaciones oportunas en el bulbo de proa y el codaste de la carena obtenida por el método paramétrico. De esta forma se asegura que las geometrías estudiadas en los apartados 3 y 4 de este documento se cumplen.

Se midieron sobre los planos obtenidos las medidas indicadas en el apartado 4, sobre el codaste. Se muestra en la imagen que se cumplen tales medidas, considerando un diámetro de hélice de 4 metros:



6.1- Huecos medidos en la carena obtenida por la transformación paramétrica.

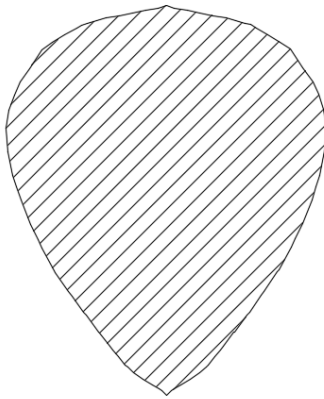
Se realizó el mismo proceso en el bulbo de proa:



6.2- Dimensiones del bulbo de proa medidas en la carena obtenida.



La sección transversal del bulbo es en esta carena de tipo peonza, obteniéndose el área transversal midiendo en el plano:



$$S_b = 13,16 \text{ m}^2$$

6.3- área transversal del bulbo de proa

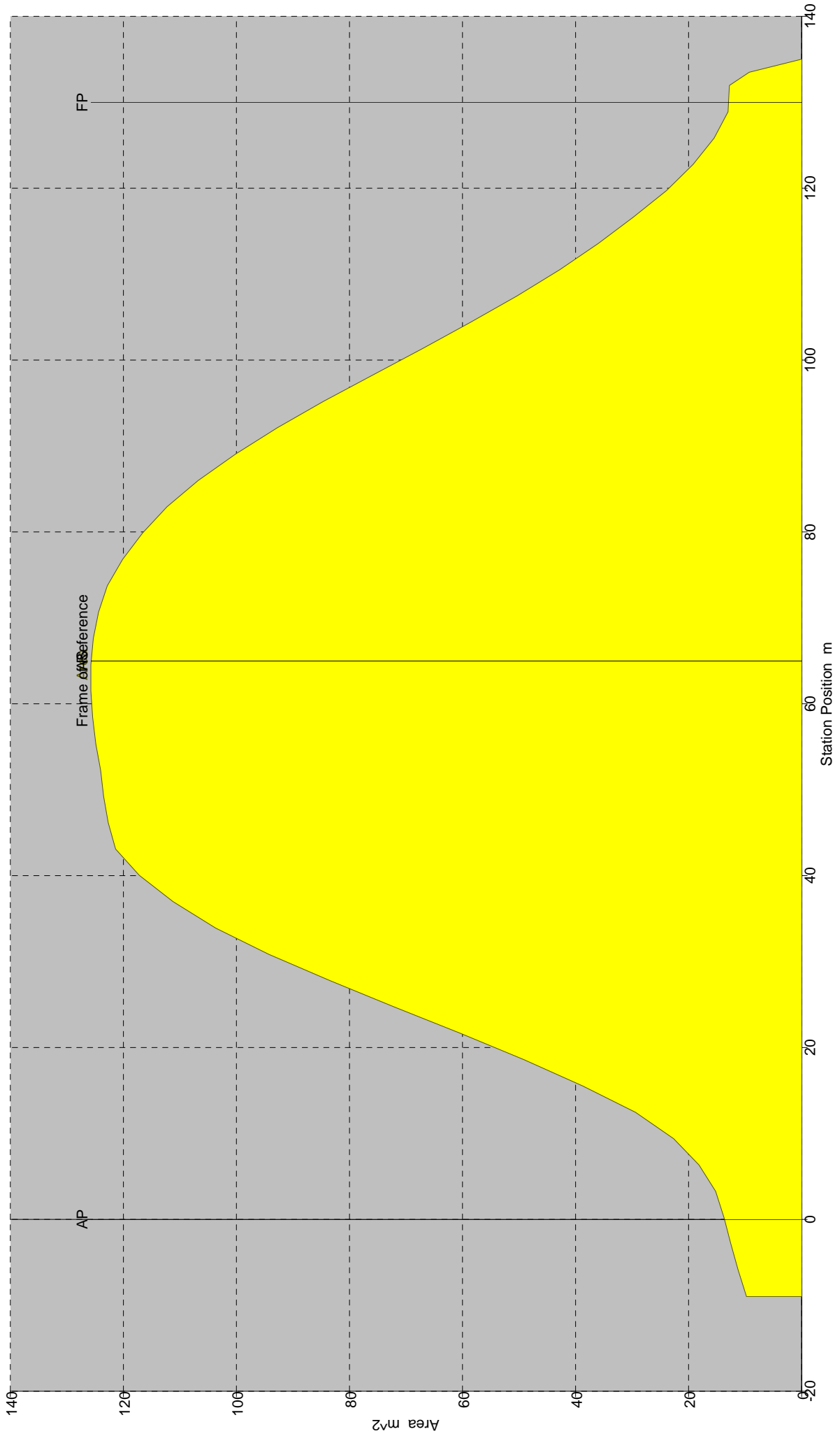


7. Cálculo de hidrostáticas al calado de diseño y curva de áreas:

Se muestran las hidrostáticas calculadas mediante el programa maxsurf para la carena obtenida (método paramétrico):

Displacement	10431	t
Volume (displaced)	10176,5	m ³
Draft Amidships	5,250	m
Immersed depth	5,250	m
WL Length	138,13	m
Beam max extents on WL	24,4	m
Wetted Area	4029,33	m ²
Max sect. area	123,66	m ²
Waterpl. Area	2698,84	m ²
Prismatic coeff. (Cp)	0,596	
Block coeff. (Cb)	0,575	
Max Sect. area coeff. (Cm)	0,966	
Waterpl. area coeff. (Cwp)	0,800	
LCB length	59,058	from zero pt. (+ve fwd) m
LCF length	49,054	from zero pt. (+ve fwd) m
LCB %	42,753	from zero pt. (+ve fwd) % Lwl
LCF %	35,511	from zero pt. (+ve fwd) % Lwl
KB	2,999	m
KG fluid	0,000	m
BMt	13,564	m
BML	303,98	m
GMt corrected	16,563	m
GML	306,98	m
KMt	16,563	m
KML	306,98	m
Immersion (TPc)	27,663	tonne/cm
MTc	245,87	tonne.m
RM at 1deg = GMt.Disp.sin(1)	3015,15	tonne.m
Length:Beam ratio	5,660	
Beam:Draft ratio	4,649	
Length:Vol^{0.333} ratio	6,375	

A continuación se muestra la curva de áreas correspondiente:



Curve of Areas View



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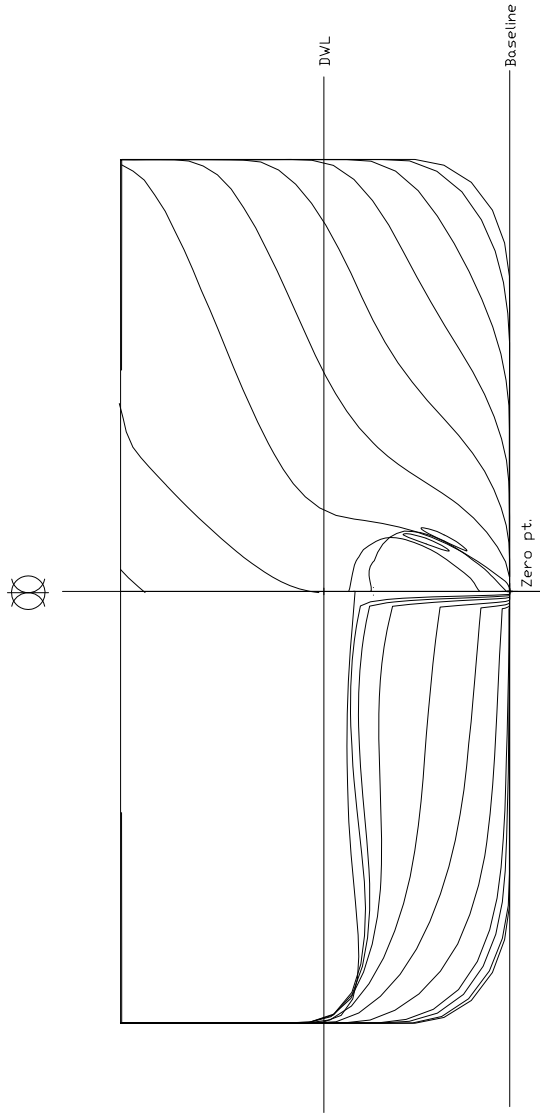
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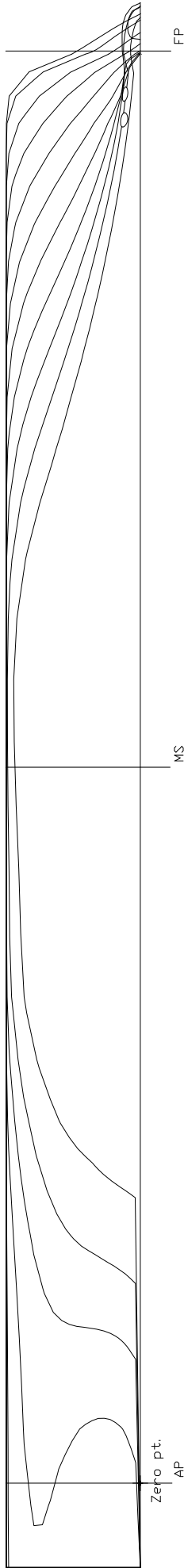
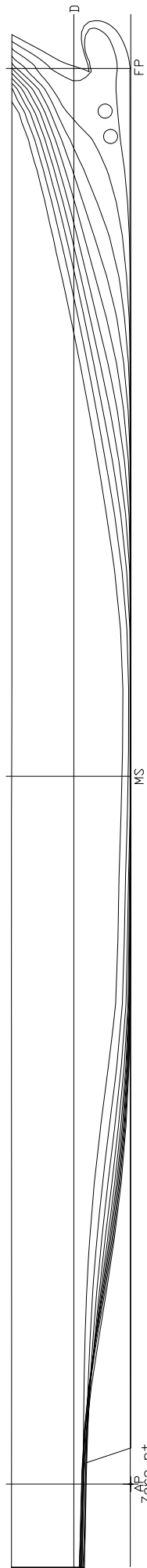
Grado en Ingeniería Naval y Oceánica

Documento

PLANOS



Proyecto:	Ferry 1500 pax y 1000 ml	Fecha:
Autor:	Marcos Covelo Fernández	
Peticionario:		
EPS.	CAJA DE CUADERNAS	
	Plano N°	
	Escola: 1:400	



Proyecto: Ferry 1500 pax y 1000 ml

Fecha:

Autor: Marcos Covelo Fernández

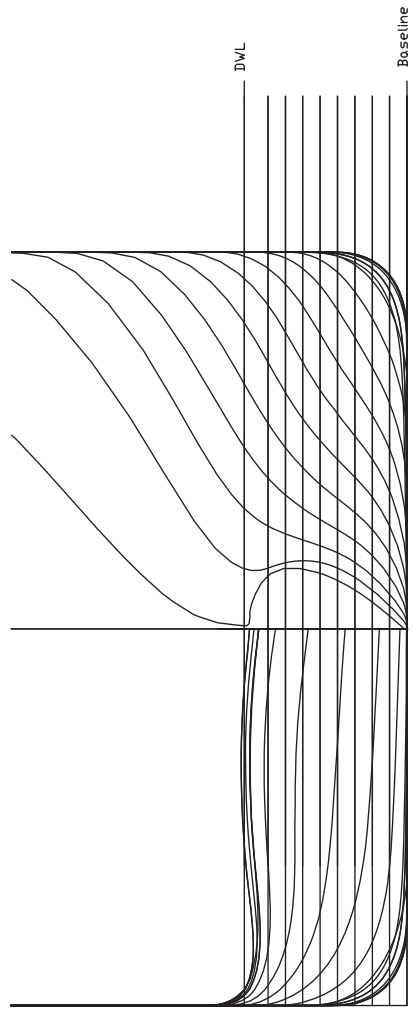
Peticionario:

LONG, Y L.A,


Plano N°

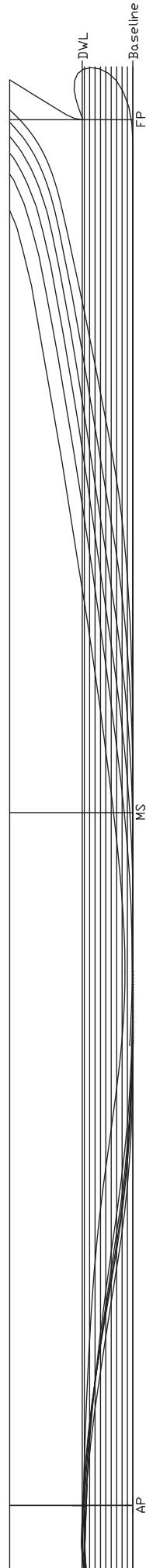
Escala: 1:400

E.P.S.




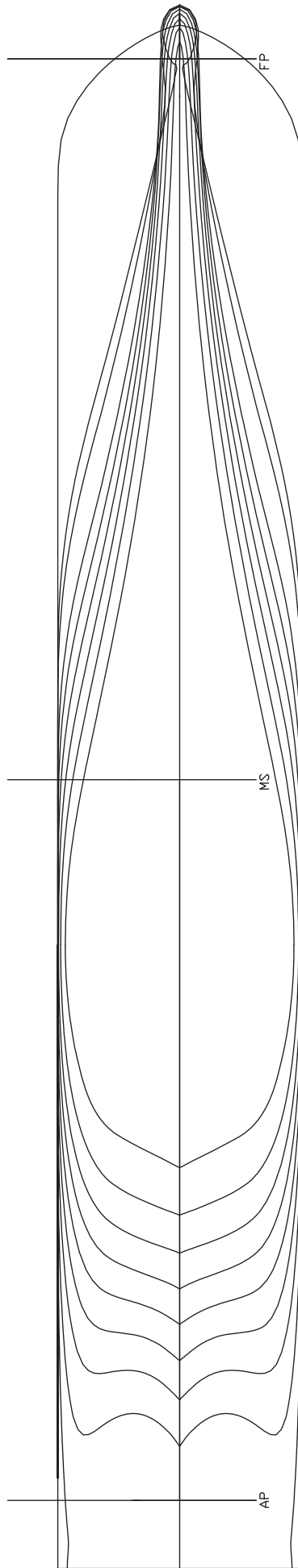
ESLORA TOTAL.....180.28 m
 MANGA DE TRAZADO.....28.2 m
 PUNTAL A LA CUBIERTA PRINCIPAL.. 9.53 m
 PUNTAL A LA CUBIERTA SUPERIOR.. 14.83 m
 CALADO DE ESCANTILLONADO..... 6.09 m
 PASAJE..... 950 personas
 TRIPULACIÓN..... 50 personas

 E.P.S. GRADO EN ARQUITECTURA NAVAL	TRABAJO FIN DE GRADO NÚMERO: 14 - 105
	TÍTULO DEL PROYECTO: RO - RO 1000 PAX.
TÍTULO DEL PLANO: PLANO DE FORMAS (SECCIÓN Nº: 20)	
AUTOR: MARÍA DE LA LUZ MUIRAS CASAS	FIRMA:
FECHA: SEPTIEMBRE 2014	
ESCALA: 1:200	
PLANO Nº: 01 / 05	




ESLORA TOTAL.....180.28 m
 MANGA DE TRAZADO..... 28.2 m
 PUNTAL A LA CUBIERTA PRINCIPAL.. 9.53 m
 PUNTAL A LA CUBIERTA SUPERIOR.. 14.83 m
 CALADO DE ESCANTILLONADO..... 6.09 m
 PASAJE..... 950 personas
 TRIPULACIÓN..... 50 personas

 E.P.S. GRADO EN ARQUITECTURA NAVAL	TRABAJO FIN DE GRADO NÚMERO: 14 - 105
	TÍTULO DEL PROYECTO: RO - RO 1000 PAX.
TÍTULO DEL PLANO: SECCIÓN PERFIL	FECHA: SEPTIEMBRE 2014
AUTOR: MARÍA DE LA LUZ MUIRAS CASAS	ESCALA: 1:500
FIRMA:	PLANO Nº: 02 / 05



ESLORA TOTAL.....180.28 m
 MANGA DE TRAZADO..... 28.2 m
 PUNTAL A LA CUBIERTA PRINCIPAL.. 9.53 m
 PUNTAL A LA CUBIERTA SUPERIOR.. 14.83 m
 CALADO DE ESCANTILLONADO..... 6.09 m
 PASAJE..... 950 personas
 TRIPULACIÓN..... 50 personas

 UNIVERSIDADE DA CORUÑA	E.P.S. GRADO EN ARQUITECTURA NAVAL	TRABAJO FIN DE GRADO NÚMERO: 14 - 105
	TÍTULO DEL PROYECTO: RO - RO 1000 PAX.	
TÍTULO DEL PLANO: SECCIÓN PLANTA		FECHA: SEPTIEMBRE 2014
AUTOR: MARÍA DE LA LUZ MUIRAS CASAS	FIRMA:	ESCALA: 1:500
		PLANO Nº: 03 / 05



UNIVERSIDADE DA CORUÑA



Escola Politécnica Superior

Trabajo Fin de Grado
CURSO 2016/17

17-07 FERRY 1500 PAX 1000 ML

Grado en Ingeniería Naval y Oceánica

Documento

ANEXO



Cartilla de trazado:

Secc.		1	2	3	4	5	6	7	8	9	10	11	12
L.A.	Medidas en m.	4,678	9,356	14,034	18,711	23,389	28,067	32,745	37,423	42,101	46,778	51,456	56,134
I	6,837	5,323	8,034	9,443	10,182	10,524	10,637	10,65	10,65	10,65	10,65	10,65	10,65
II	5,673	5,655	8,218	9,534	10,22	10,536	10,638	10,65	10,65	10,65	10,65	10,65	10,65
III	4,509	6,014	8,41	9,628	10,258	10,547	10,64	10,65	10,65	10,65	10,65	10,65	10,65
IV	3,346	6,394	8,606	9,721	10,297	10,558	10,641	10,65	10,65	10,65	10,65	10,65	10,65
V	2,182	6,789	8,802	9,814	10,334	10,569	10,642	10,65	10,65	10,65	10,65	10,65	10,65
VI	1,018	7,188	8,994	9,903	10,369	10,579	10,644	10,65	10,65	10,65	10,65	10,65	10,65
VII	-0,145	7,29	9,056	9,939	10,386	10,585	10,645	10,65	10,65	10,65	10,65	10,65	10,649
VIII	-1,309				8,877	10,26	10,538	10,612	10,638	10,647	10,65	10,65	10,649
IX	-2,473							9,599	10,25	10,446	10,52	10,546	10,553
X	-3,636									8,939	9,82	10,015	10,062

Secc.		13	14	15	16	17	18	19	20	21	22	23	24
L.A.	Medidas en m.	60,812	65,49	70,168	74,846	79,523	84,201	88,879	93,557	98,235	102,913	107,59	112,268
I	6,837	10,648	10,641	10,624	10,582	10,462	10,156	9,59	8,822	7,925	6,934	5,855	3,024
II	5,673	10,647	10,639	10,617	10,565	10,421	10,059	9,392	8,498	7,474	6,376	5,216	2,202
III	4,509	10,647	10,636	10,61	10,546	10,376	9,953	9,176	8,146	6,988	5,78	4,545	1,304
IV	3,346	10,646	10,633	10,601	10,526	10,328	9,84	8,944	7,764	6,465	5,147	3,847	
V	2,182	10,645	10,63	10,593	10,504	10,276	9,718	8,693	7,353	5,904	4,478	3,125	
VI	1,018	10,645	10,627	10,583	10,481	10,221	9,587	8,424	6,912	5,304	3,774	2,387	
VII	-0,145	10,644	10,623	10,573	10,456	10,162	9,449	8,136	6,439	4,666	3,037	1,614	
VIII	-1,309	10,642	10,617	10,555	10,412	10,066	9,262	7,835	6,059	4,356	3,093	2,342	1,227
IX	-2,473	10,547	10,52	10,449	10,287	9,911	9,08	7,664	5,999	4,513	3,418	-0,425	1,349
X	-3,636	10,067	10,048	9,985	9,822	9,432	8,578	7,159	5,553		3,139	2,397	0,994



Main Particulars:



Length Overall (with appendixes): 130.45 m
Length Overall (hull): 126.10 m
Length between Perpendiculars: 115.45 m
Moulded Breadth: 21.60 m
Depth to the Deck No. 3 (main deck): 7.50 m
Depth to the Deck No. 5 (upper deck): 12.80 m
Total Number of Decks: 8
Design Draught: 5.00 m
Summer Draught: 5.00 m
Deadweight at Summer Draught: 1745 T
Service Speed: 22.5 knots
Service Range: 2000 miles approx.
Number of Superstructure Decks: 3

Classification:

Bureau Veritas: I✕HULL ✕MACH, RO-RO PASSENGER SHIP, UNRESTRICTED NAVIGATION, AUT-UMS

Propulsion & Manoeuvring Equipment:

Main Engines: 4 x 4500 kW at 600 rpm
Generating Sets: 2 x 1080 kW at 1000 rpm
Emergency Genset: 1 x 310 kW at 1500 rpm
 2 x CP Main Propellers, 4 Blades, 3700 mm Diameter
 2 x 720 kW CP Bow Tunnel Thrusters

Cargo Capacity:

Max. Capacity (crew + passengers): 1500 people
Number of Cargo Decks: 2 + 1 cardeck
Cargo Capacity with Cars and Trailers:
Cars Capacity: 213 / *Trailers Capacity:* 16
Max. Cargo Capacity for Trailers of 16 m and Cars:
Trailers Capacity: 28 / *Cars Capacity:* 103
Max. Cargo Capacity with Only Cars:
Capacity for Cars: 305

Cargo Equipment:

2 *Stern Ramp Doors:* 9.5 m length x 6.0 m width
 Tilting Ramp for Access to Upper Deck
 Fore Ramp-door with Bow Visor for the Access of Cars from Dock
 A Movable Ramp (cardeck) in Garage between upper Deck No. 3 and 5 for transport of cars of 2 T weight

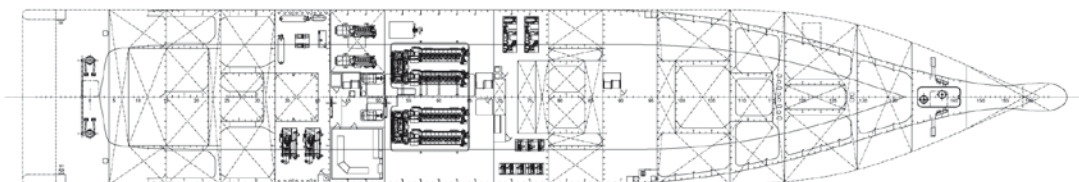
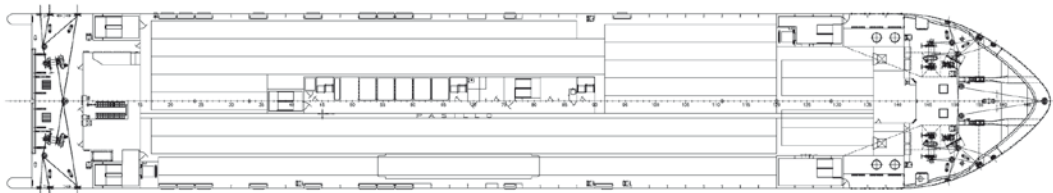
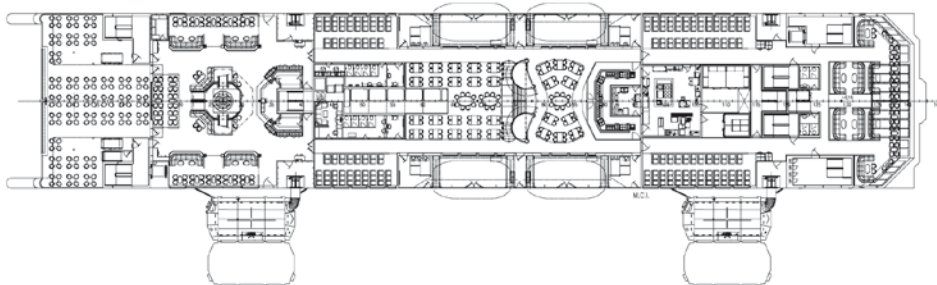
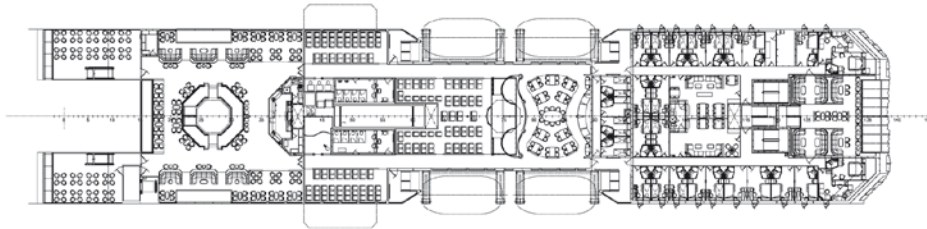
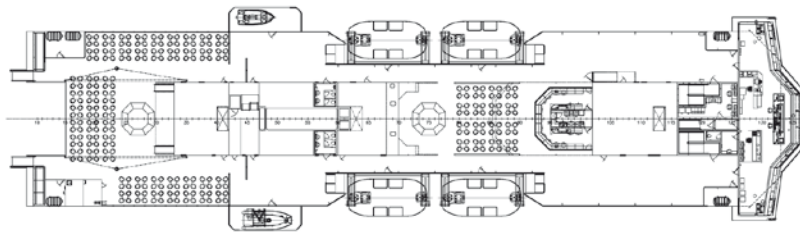
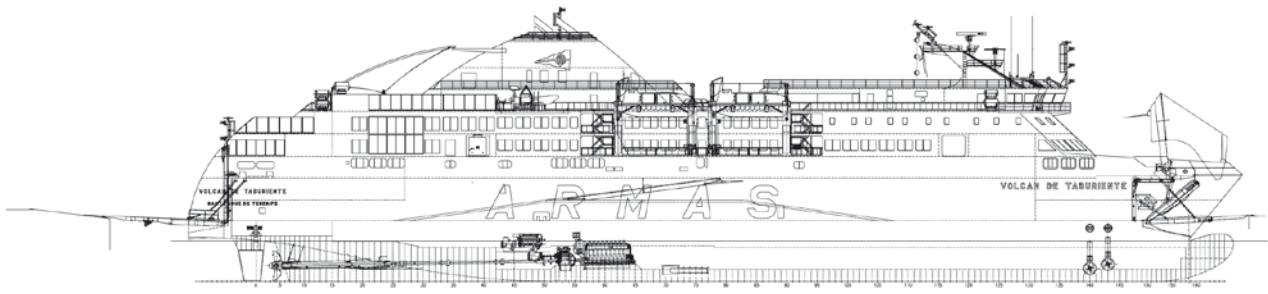
Tanks Capacity:

Fuel Capacity (Fuel-oil): 358 m³ / *Fuel Capacity (Diesel-oil):* 47 m³
Lub. Oil Capacity: 42 m³
Fresh Water Capacity: 66 m³
Ballast Water Capacity: 1130 m³

Hull N°:
1650

Name:
VOLCÁN DE TABURIENTE

Built:
2006





ARMORIQUE: new ro-pax ferry for Plymouth-Roscoff route

Shipbuilder: **Aker Yards (Helsinki yard), Finland**
 Vessel's name: **Armorique**
 Hull number: **1362**
 IMO number: **9364980**
 Owner/operator: **Brittany Ferries, France**
 Designer: **AIA Architects, France**
 Model test establishment used: **Force Technology, Denmark**
 Flag: **France**
 Total number of sister ships already completed: **Nil**
 Total number of sister ships still on order: **Nil**

ORIGINALLY ordered from Aker Yards (today STX Europe) as a freight-ferry sister to *Cotentin* (*Significant Ships of 2007*), *Armorique* resulted from a contract quickly changed to create a full ro-pax design for Brittany Ferries to satisfy the company's more urgent requirement for a vessel to operate on its Plymouth-Roscoff service. The conversion was facilitated by retaining the basis hull of *Cotentin*, but modifying and restyling the spaces above deck 5.

A new profile is now presented, with decks 7 to 10 extended right aft, to provide accommodation for 1500 passengers, 780 of whom can be carried as 'overnight' travellers using 248 cabins, including some suites. Once onboard, passengers have the use of a cinema, and a variety of bars, lounges and restaurants, with dedicated areas arranged for teenagers. A large shopping area is also provided and reclining seats are available for day passengers.

Vehicles are carried on three fixed decks offering a total of 1100 lane metres, equating to a total of 500 cars or some 60 trucks and, with a fast turnaround in port a requirement, two-level access is provided at both bow and stern. MacGregor supplied the access equipment, which includes a bow door and door ramp, a stern door/ramp, a ramp cover for the lower hold fixed ramp and a tilting ramp between decks 3 and 5.

The machinery installation follows closely that of *Cotentin* and uses the same MaK 12VM43C main engines, manufactured by Caterpillar Motoren GmbH, the organisation now controlling MaK, following its acquisition by the Caterpillar Group. The two engines fitted in the three-quarter aft machinery space each develop 12,000kW, and are coupled to twin CP propellers through Flender gearboxes which reduce engine speed to 153rev/min. When running at 85% MCR, a service speed of 23knots is attained.

Alternator capacity has been increased above that for *Cotentin* and consists of a Leroy Somer 2800kW alternator driven from a PTO on each gearbox, and three Wärtsilä/A van Kaick 1152kW diesel-driven sets. Environmental issues have been paramount in the

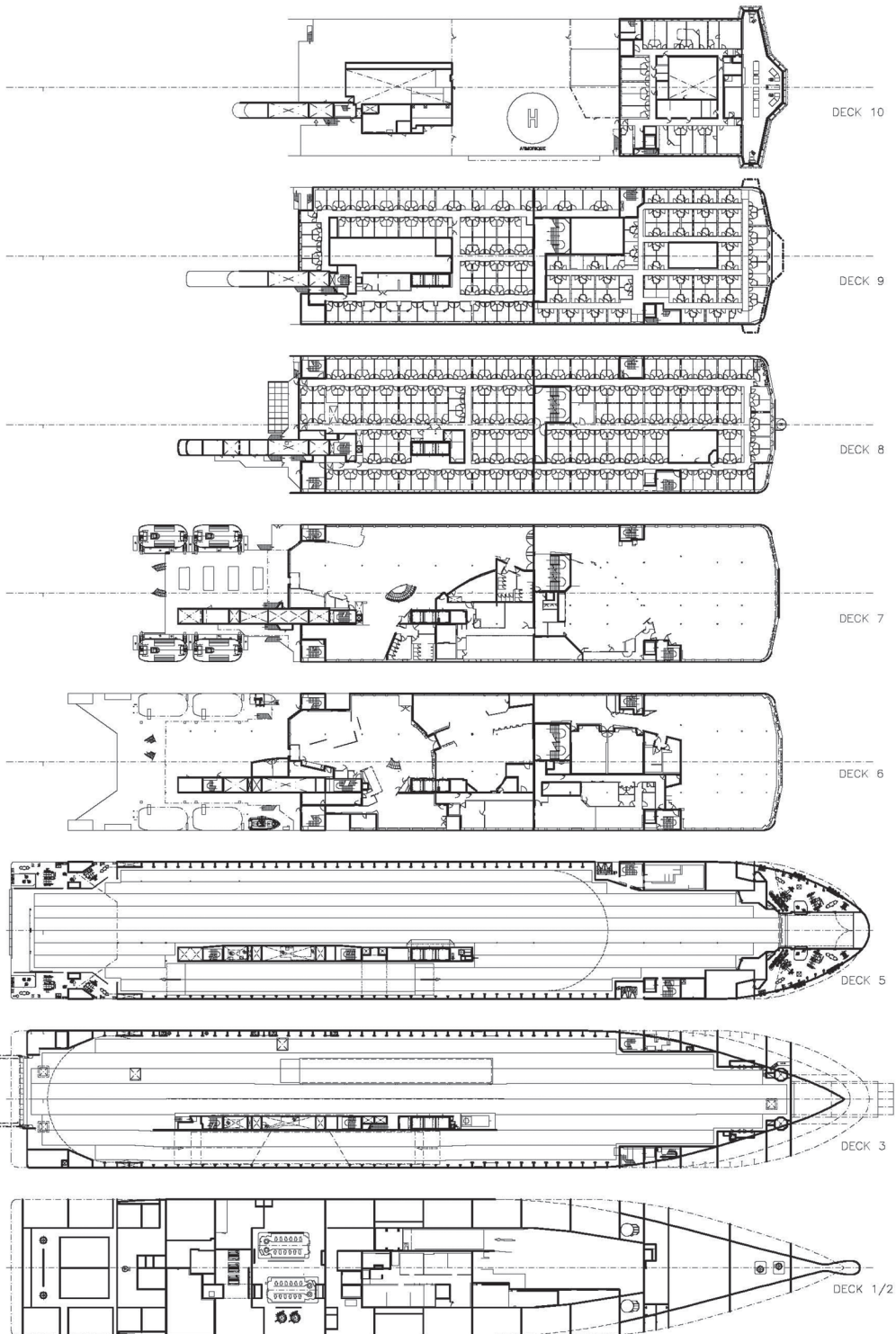
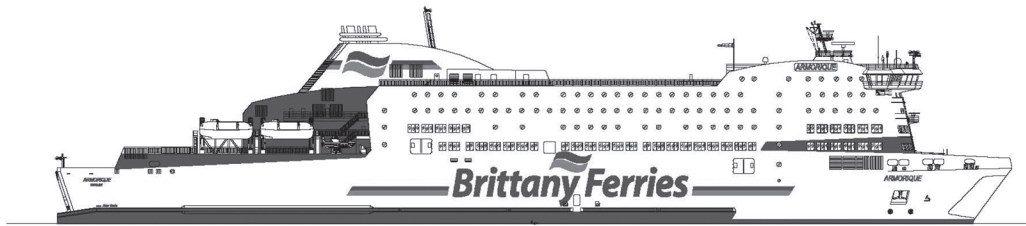
development of the design of both *Cotentin* and *Armorique*, with particular attention paid to CO₂ emissions.

Two bow thrusters and one stern unit, supplied by Wärtsilä Lips, are installed, the former producing 1200kW each, and the stern unit 900kW. Passenger comfort is a particular consideration, and a pair of fin stabilisers is fitted; heeling tanks are also included for stability control during cargo handling. Lifesaving equipment supplied includes four RDF MES installations with vertical chutes: two arranged for 430 persons each and two of 321 person capacity. Four 150 person Umoe Schat-Harding lifeboats are also carried.

TECHNICAL PARTICULARS

Length, oa 168.00m
 Length, bp 155.00m
 Breadth, moulded 26.80m
 Depth, moulded
 to main deck 9.30m
 to upper deck 10.30m
 Draught
 design 6.30m
 scantling 8.50m
 Gross approx 28,500gt
 Deadweight, design 4200dwt
 Speed, service, 85% MCR 23knots
 Bunkers
 heavy oil 790m³
 diesel oil 170m³
 Water ballast 2060m³
 Fuel consumption
 main engines only 110tonnes/day
 auxiliaries 9tonnes/day
 Classification Bureau Veritas I, +Hull, Ro-Ro Passenger Ship, Unrestricted Navigation, +MACH, +AUT-IMS, +AUT-PORT, SYSNEQ-1, MON-SHAFT
 Heel control equipment Two pairs of heeling tanks
 Roll-stabilisation equipment Fin stabilisers
 Main engines
 Design MaK
 Model 12VM43C
 Manufacturer Caterpillar Motoren GmbH
 Number 2
 Type of fuel HFO
 Output 2 x 12,000kW
 Gearboxes
 Make Flender
 Model Navilus GHCK
 Number 2
 Output speed 153rev/min
 Propellers
 Material CuNiAl
 Designer/manufacturer Wärtsilä
 Number 2
 Pitch Controllable
 Diameter 4800mm
 Speed 153rev/min
 Main-engine driven alternators
 Number 2
 Make Leroy Somer
 Output/speed 2 x 2800kW/1500rev/min

Diesel-driven alternators
 Number 3
 Engine make/type Wärtsilä/6L20C
 Type of fuel HFO
 Output/speed 3 x 1200kW/1000rev/min
 Alternator make/type A van Kaick/DSG 86/L1-6W
 Output/speed 3 x 1152kW/1000rev/min
 Boilers
 Number/type 2 x convection tube
 Make Aalborg
 Output 2 x 3100kg/h
 Mooring equipment
 Number of units 8
 Make Rolls-Royce
 Type Electro-hydraulic
 Lifesaving equipment
 MES stations RFD: 2 x 430person; 2 x 321person vertical chutes
 Lifeboats Umoe Schat-Harding: 4 x 150 person
 Vehicles
 Number of vehicle decks 3 x fixed
 Total lane length 1100m
 Total cars 500
 Total freight vehicles 60
 Access equipment
 Designer MacGregor
 Number/type 1 x bow door; 1 x bow ramp; 1 x stern door/ramp; 1 x cover for lower hold fixed ramp; 1 x tiltable ramp
 Complement
 Officers 24
 Crew 82
 Passengers 1500
 Total number of cabins 248
 Bow thrusters
 Make Wärtsilä Lips
 Number 2
 Output 2 x 1200kW
 Stern thruster
 Make Wärtsilä Lips
 Number 1
 Output 900kW
 Bridge control system
 Make Sperry
 One man operation Yes
 Fire detection system
 Make/type Autronica/BS-320
 Fire extinguishing systems Novenco
 Radars
 Number 3
 Make Sperry Marine
 Models BridgeMaster
 Integrated bridge system Sperry Marine
 Waste disposal plant
 Cardboard compactor Usion
 Waste shredder Usion dry water chute
 Glass chute with crusher Usion
 Sewage treatment system Evac MPS 800
 Contract date 19 January 2006
 Launch/float-out date 7 August/11 September 2008
 Delivery date December 2008





Main Particulars:



Length Overall (with appendixes): 154.51 m

Length Overall: 150.91 m

Length between Perpendiculars: 137.00 m

Moulded Breadth: 24.20 m

Depth to Upper Deck: 13.55 m

Depth to Main Deck: 8.35 m

Extreme Draught: 5.80 m

Design Moulded Draught: 5.50 m

Deadweight at 5.50 m approx.: 3200 T

Service Speed: 21.60 knots

Range at Service Speed: 3000 miles

Classification:

Bureau Veritas: 1✳Hull✳MACH Ro-Ro passenger ship, unrestricted navigation, AUT-UMS, AUT-PORT, MON-SHAFT, INWATER SURVEY

Propulsion & Manoeuvring Equipment:

Main Engines: 2 x 9000 kW at 500 rpm

Generating Sets: 3 x 1140 kW at 1000 rpm

Emergency Gensets: 1 x 280 kW at 1500 rpm

2 x CP Main Propellers, 4 Blades, 4200 mm Diameter

2 x 1000 kW CP Bow Tunnel Thrusters

Cargo Capacity:

Max. Capacity (crew + passengers): 1000 people

No. of Cabins: 46 x 4 pax cabins, 8 x 2 pax cabins and

2 x 3 pax cabins for disabled people

Number of Cargo Decks: 2 + 1 cardeck

Maximum Cargo Capacity for Cars: 125 cars (2.1 m width)

Maximum Cargo Capacity for Trailers: 1367 LM (3.0 m width)

Cargo Equipment:

2 Stern Ramp-Doors: 16.00 m length x 8.0 m wide

1 Movable Cardeck in Garage between Deck No. 4 and 6

Fore Ramp-Door "Clamp Type" for the access of cars from shore

2 Tilting Ramps between Deck No. 3 and 4

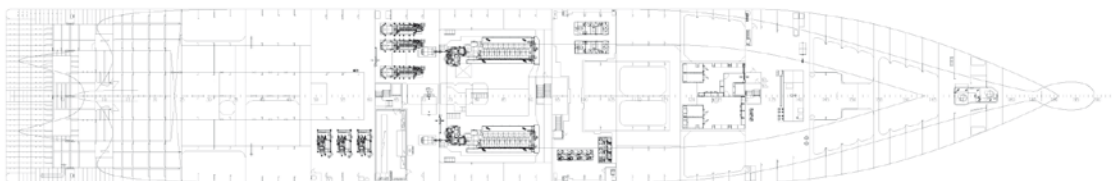
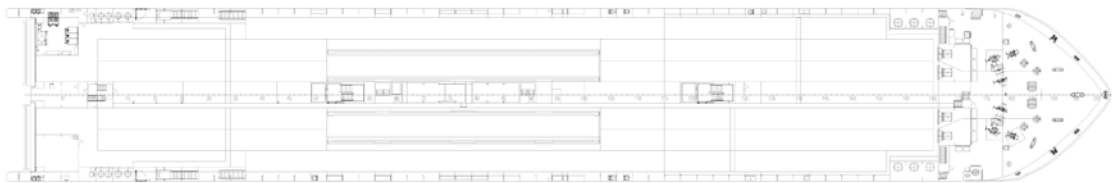
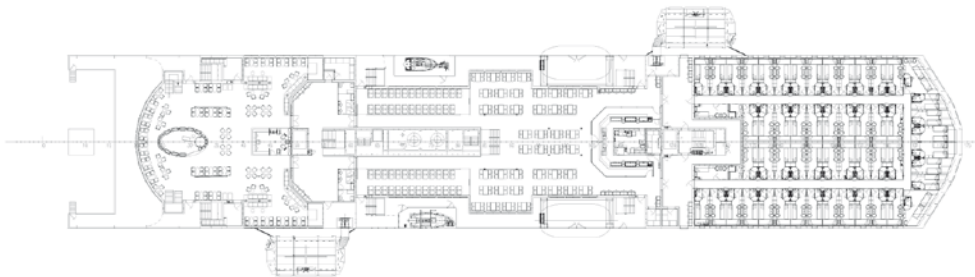
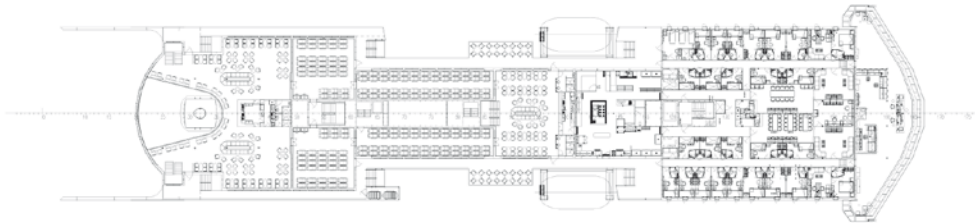
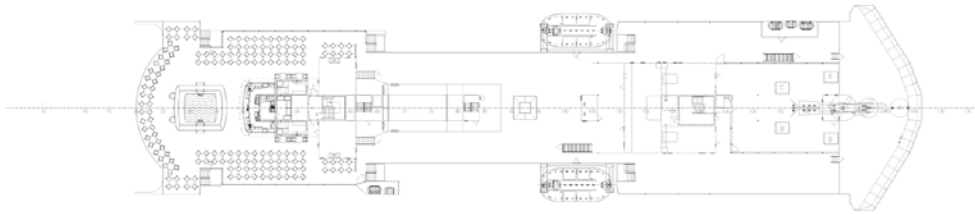
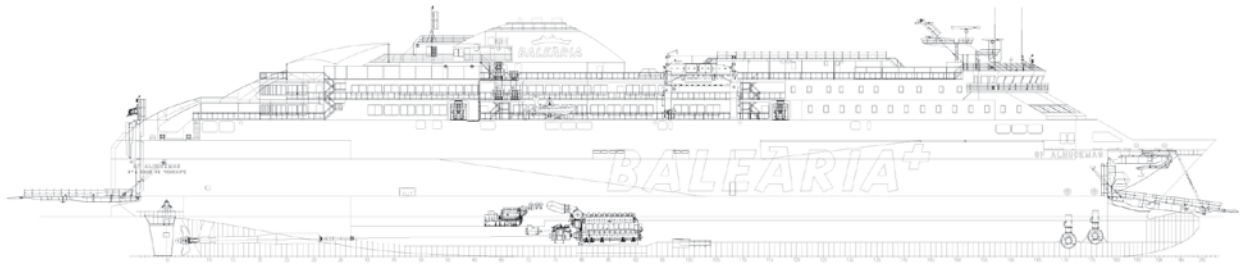
Tanks Capacity:

HFO Capacity: 611 m³

DO Capacity: 92 m³

Lub. Oil Capacity: 50 m³

Fresh Water Capacity: 134 m³



Hull Nº
1655

PASSENGER FERRY VESSEL
Shipowner:
EUROLÍNEAS MARÍTIMAS S.A.

MARTÍN i SOLER

Built:
2009



Hull Nº
1655

Main Particulars:



Length Overall (with appendixes): 165.30 m

Length Overall: 161.70 m

Length between Perpendiculars: 152.50 m

Moulded Breadth: 25.60 m

Depth to Upper Deck: 13.80 m

Depth to Main Deck: 8.50 m

Extreme Draught: 5.70 m

Design Moulded Draught: 5.50 m

Deadweight at 5.70 m approx.: 4370 T

Service Speed: 21.40 knots

Range at Service Speed: 3200 miles

Classification:

Bureau Veritas: 1*Hull*MACH Ro-Ro passenger ship, unrestricted navigation, AUT-UMS, AUT-PORT, INWATER SURVEY

Propulsion & Manoeuvring Equipment:

Main Engines: 2 x 9000 kW at 500 rpm

Generating Sets: 3 x 1100 kW at 1000 rpm

Emergency Gensets: 1 x 280 kW at 1500 rpm

2 x CP Main Propellers, 4 Blades, 4250 mm Diameter

2 x 1000 kW CP Bow Tunnel Thrusters

Cargo Capacity:

Max. Capacity (crew + passengers): 1200 people

No. of Cabins: 40 x 4 pax cabins, 4 x 2 pax cabins and 2 x 2 pax cabins for disabled people

Number of Cargo Decks: 3 + 1 cardeck

Maximum Cargo Capacity for Cars: 334 cars (2.2 m width)

Maximum Cargo Capacity for Trailers: 1711 LM (2.9 m width)

Cargo Equipment:

2 Stern Ramp-Doors: 15.50 m length x 9.5 m wide

1 Movable Cardeck in Garage between Deck No. 5 and 7

Fore Ramp-Door "Clamp Type" for the access of cars from shore

Tilting Ramp between Deck No. 2 and 3

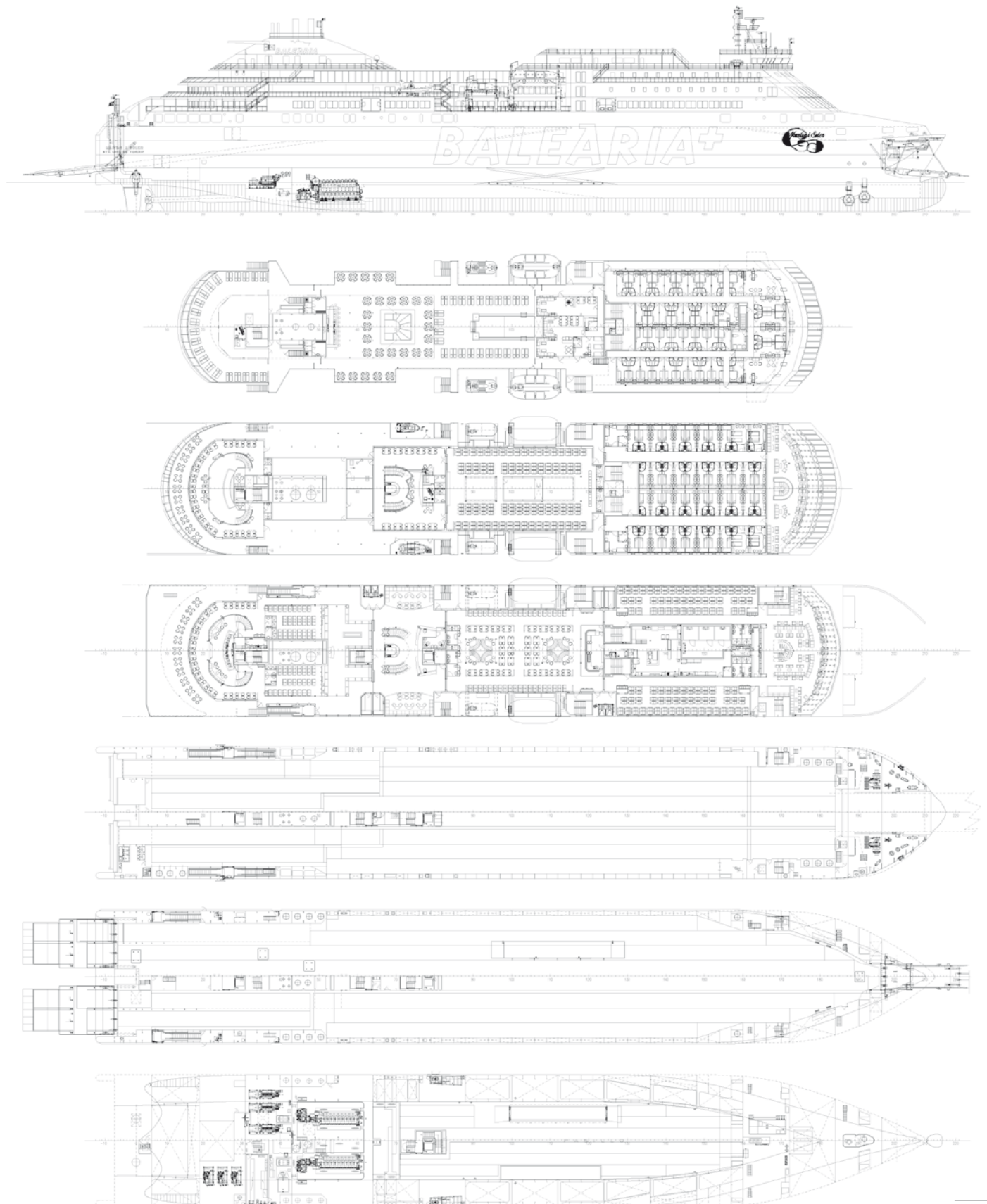
Tanks Capacity:

HFO Capacity: 660 m³

MDO Capacity: 90 m³

Lub. Oil Capacity: 28 m³

Fresh Water Capacity: 100 m³





Main Particulars:



Length Overall (with appendixes): 175.70 m

Length Overall: 171.55 m

Length between Perpendiculars: 159.00 m

Moulded Breadth: 26.40 m

Depth to upper Deck: 14.94 m

Depth to main Deck: 9.50 m

Design Moulded Draught: 6.40 m

Deadweight at 6.40 m approx.: 4850 T

Service Speed: 24.00 knots

Range at Service Speed: 3600 miles

Classification:

Bureau Veritas: 1✱Hull✱MACH Ro-Ro passenger ship, unrestricted navigation, AUT-UMS, MON SHAFT, INWATER SURVEY

Propulsion & Manoeuvring Equipment:

Main Engines: 4 x 8400 kW at 500 rpm

Generating Sets: 2 x 1100 kW at 1000 rpm

Emergency Gensets: 1 x 270 kW at 1500 rpm

2 x CP main propellers, 4 blades, 4800 mm diameter

2 x 1100 kW CP Bow Tunnel Thrusters

Cargo Capacity:

Max. Capacity (Crew + Passengers): 1500 people

No. of Cabins: 114 x 4 pax cabins, 4 x 2 pax cabins, 2 x 4 pax cabins for disabled people and 2 x 2 penthouse

No. of Cargo Decks: 3 + 1 cardeck

Maximum Cargo Capacity for Cars with Unhoistable Cardeck: 353 units (2.2 m width)

Maximum Cargo Capacity for Trailers with Unhoistable Cardeck: 1578 ml (3 m width)

Maximum Cargo Capacity for Trailers with Hoistable Cardeck: 2010 ml (3 m width)

Cargo Equipment:

2 Stern Ramp-Doors: 16.00 m length x 8.0 m wide

1 Movable Cardeck in Garage between Deck No. 5 and 7

2 Fixed Ramps between Deck No. 3 and 5: 41 m length x 3.5 m wide

Tanks Capacity:

Fuel-Oil Capacity: 916 m³

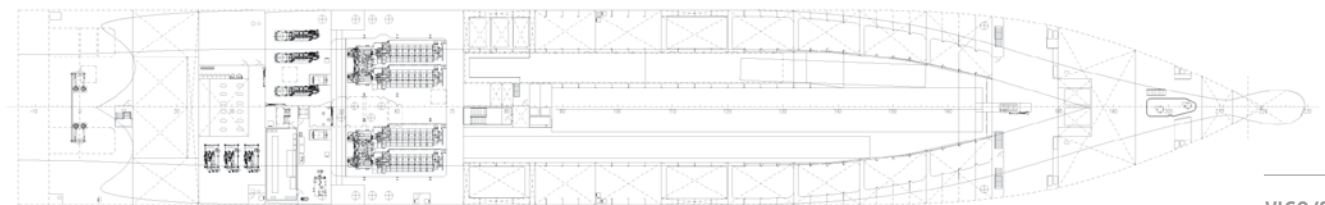
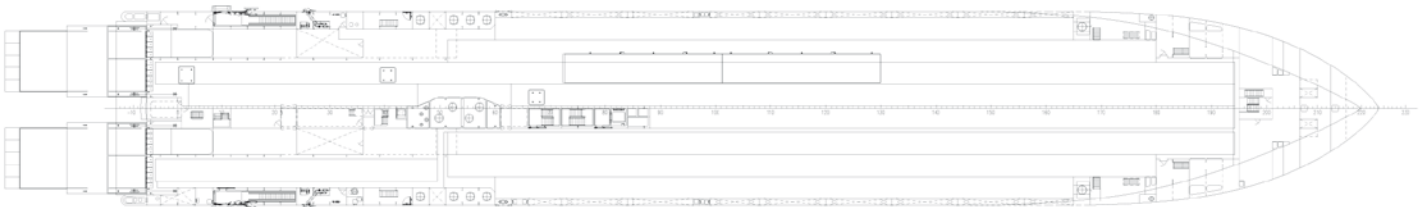
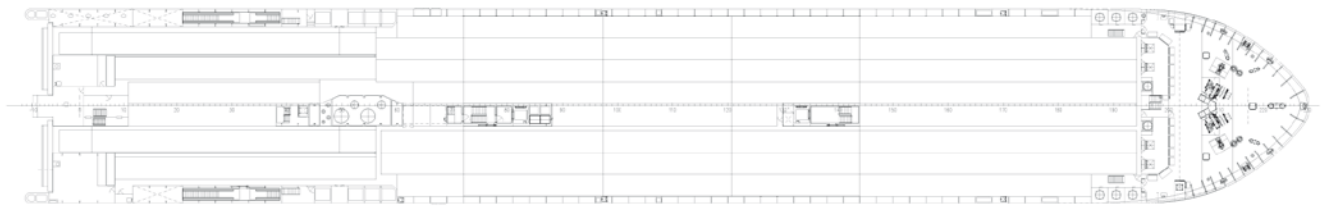
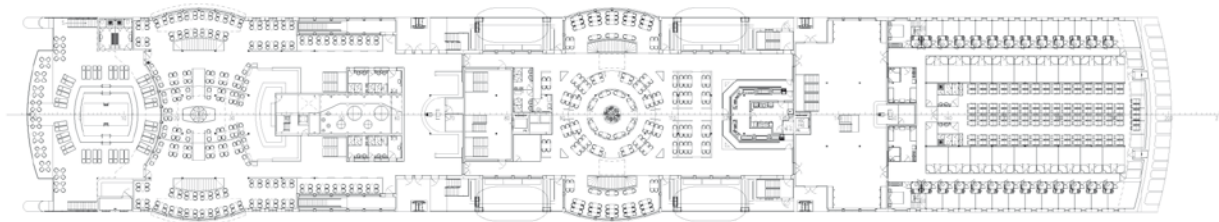
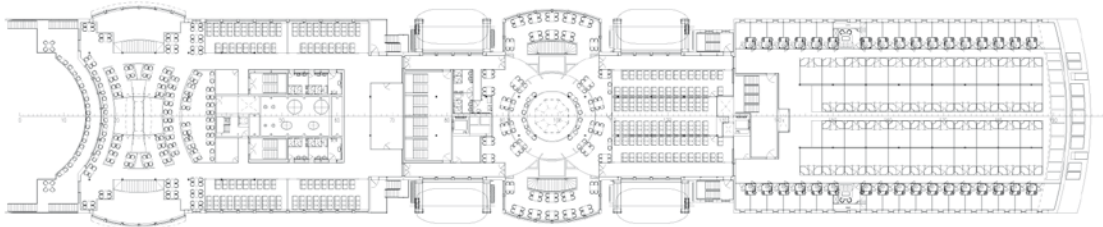
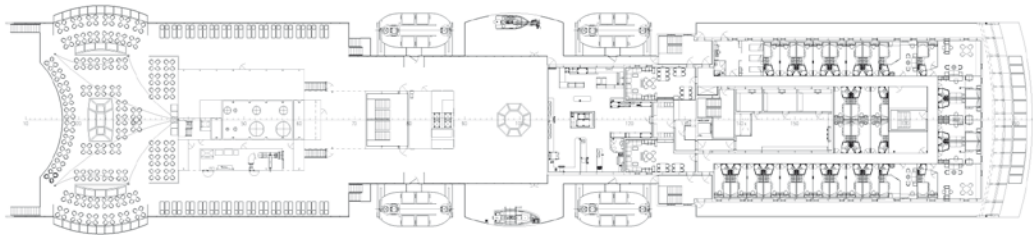
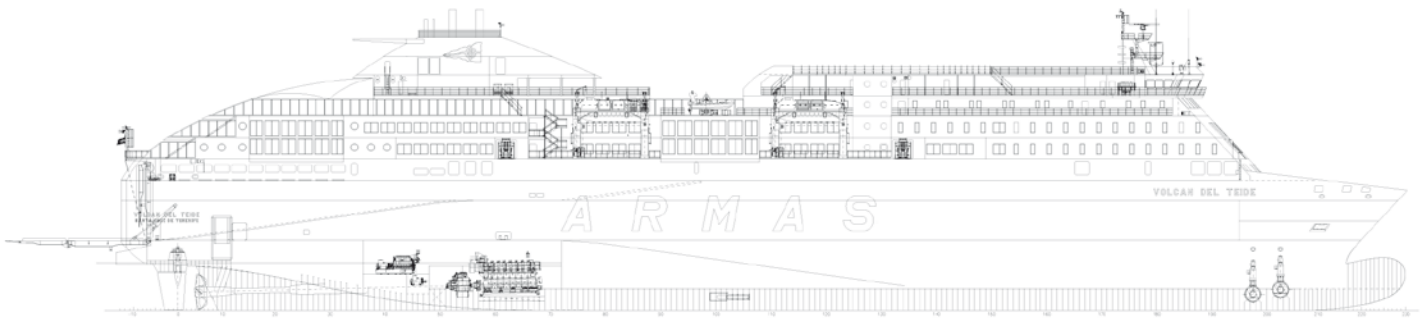
Diesel-Oil Capacity: 134 m³

Lub. Oil Capacity: 63 m³

Fresh Water Capacity: 160 m³

Hull Nº: 1666 / Name: VOLCÁN DEL TEIDE / Built: 2011

Hull Nº: 1667 / Name: VOLCÁN DE TINAMAR / Built: 2011



Hull Nº
1653

PASSENGER FERRY VESSEL

Shipowner:
NAVIERA ARMAS

VOLCAN DE TAMADABA

Built:
2007

Hull Nº
1654

VOLCAN DE TIJARAFE

Built:
2008



Main Particulars:



Length Overall: 154.51 m

Length between Perpendiculars: 137.00 m

Moulded Breadth: 24.20 m

Depth to Main Deck: 8.53 m

Extreme Draught: 5.80 m

Design Moulded Draught: 5.50 m

Deadweight at 5.50 m approx.: 3350 T

Service Speed: 23 knots

Range at Service Speed: 2200 miles

Classification:

I*Hull*MACH Ro-Ro passenger ship, Unrestricted navigation, AUT-UMS, MON-SHAFT, INWATER SURVEY

Propulsion & Manoeuvring Equipment:

Main Engines: 2 x 11700 kW at 500 rpm

Generating Sets: 2 x 1200 kW at 1000 rpm

Emergency Gensets: 1 x 250 kW at 1500 rpm

2 x CP Main Propellers, 4 Blades, 4200 mm Diameter

2 x 1000 kW CP Bow Tunnel Thrusters

Cargo Capacity:

Max. Capacity (crew + passengers): 1000 people

No. of Cabins: 46 x 4 pax cabins, 8 x 2 pax cabins and 8 x 2 pax cabins for disabled people

No. of Cargo Decks: 2 + 1 cardeck

Cargo Capacity with Cars and Trailers: 174 cars and 57 trailers

Cargo Capacity only with Trailers: 80 Trailers

Cargo Equipment:

2 *Stern Ramp-Coors:* 16 m length x 8 m wide

1 movable Cardeck in Garage between Upper Deck No. 4 and Deck No. 6

Tanks Capacity:

Fuel-Oil Capacity: 616 m³

Diesel-Oil Capacity: 92 m³

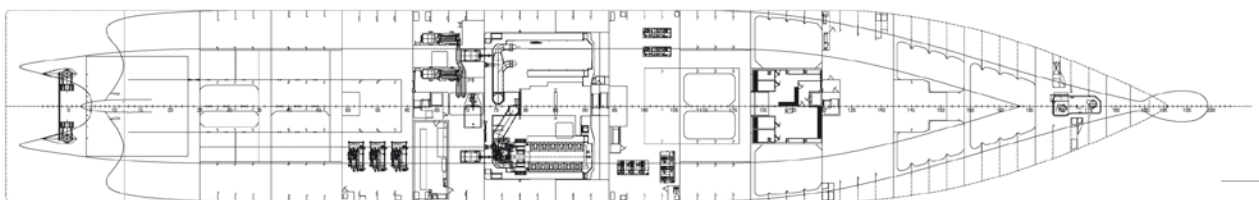
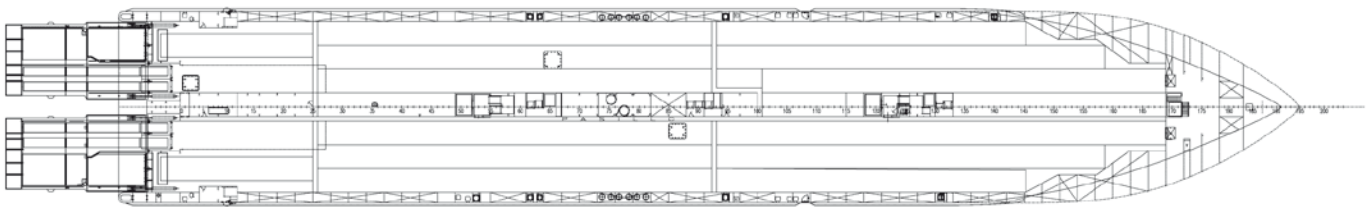
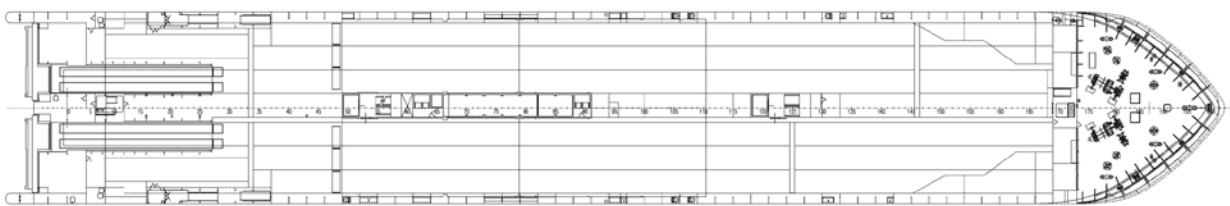
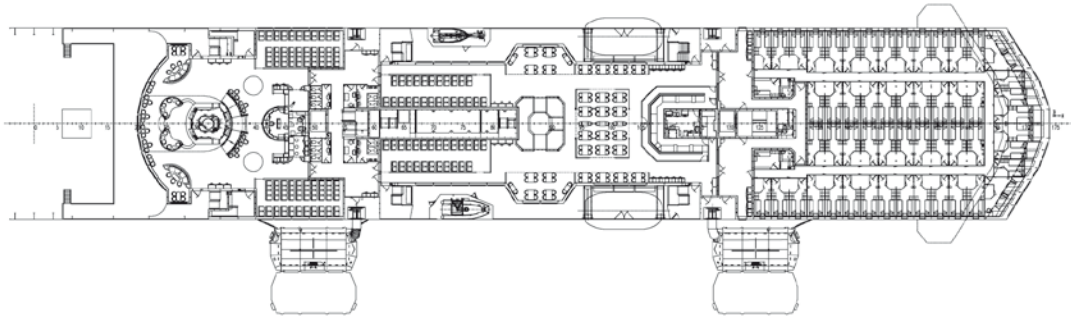
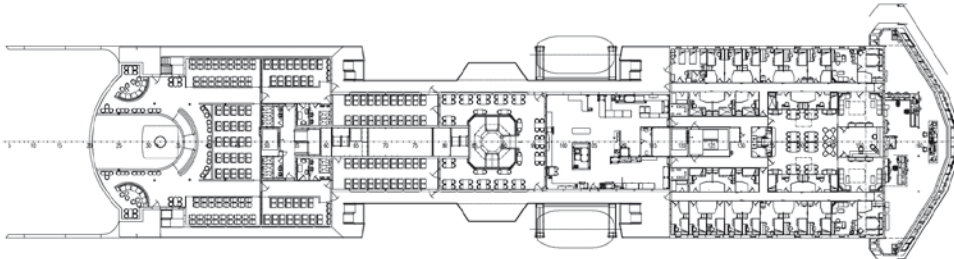
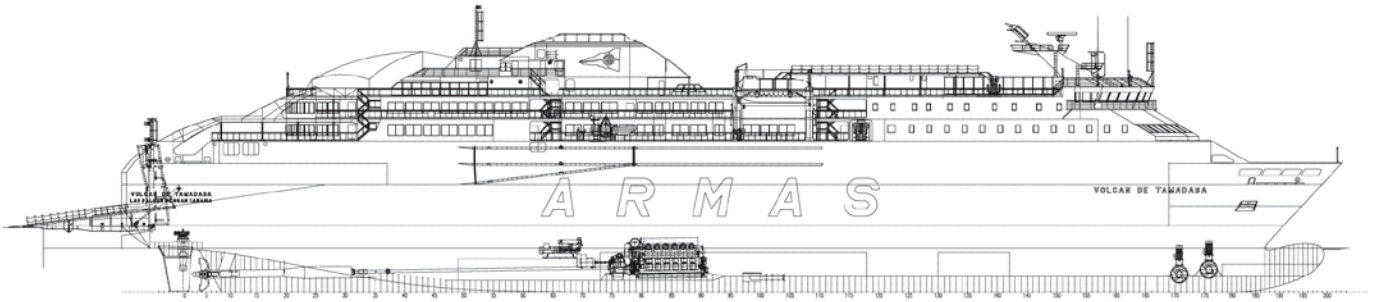
Lub. Oil Capacity: 54 m³

Fresh Water Capacity: 93 m³

Ballast Water Capacity: 1826 m³

Hull Nº: 1653 / Name: VOLCAN DE TAMADABA / Built: 2007

Hull Nº: 1654 / Name: VOLCAN DE TIJARAFE / Built: 2008





Main Particulars:



Length Overall: 142.45 m
Length between Perpendiculars: 125.00 m
Moulded Breadth: 24.20 m
Depth to Deck No. 3 (Main Deck): 8.35 m
Depth to Deck No. 4 (Upper Deck): 13.55 m
Total Number of Decks: 8
Design Draught: 5.70 m
Scantling Draught: 6.00 m
Summer Draught: 5.70 m
Deadweight at Summer Draught: 3350 T
Service Speed: 22 knots
Number of Superstructure Decks: 3

Classification:

Bureau Veritas: I ✽HULL ✽MACH, RO-RO PASSENGER SHIP, UNRESTRICTED NAVIGATION, INWATER SURVEY, AUT-UMS

Propulsion & Manoeuvring Equipment:

Propelling Power: 2 x 8400 kW = 16800 kW
Generating Sets: 2 x 1100 kW at 1000 rpm
Number of Propellers: 2
Propeller Revolutions: 176 rpm
Emergency Genset: 1 x 270 kW at 1500 rpm
Bow Thrusters: 2 transverse variable pitch bow thrusters x 1000 kW each, electrically driven

Cargo Capacity:

Max. Capacity (Crew + Passengers): 1000 people
Cabins: 46x4 pax, 8x2 pax, 2x3 pax for disabled people
Number of Cargo Decks: 2 + 1 cardeck
Cargo Capacity with Cars and Trailers:
Lanes length of 2.10 m wide: 1970 m / *Lanes length of 3.00 m wide:* 600 m
Capacity for Cars: 404 / *Capacity for Trailers:* 33
Cargo Capacity Only with Trailers:
Lanes Length of 3.00 m wide: 1270 m / *Trailers Capacity:* 69

Cargo Equipment:

2 Stern Ramp-Doors: 16.0 m length x 8.0 m width
 2 Fixed Ramps: 38.0 m length x 3.5 m width
 1 Hoistable Cardeck between Upper Deck and Deck 6
 2 Hoistable Ramps for Access to the Cardeck from Upper Deck Aft
 2 Hoistable Ramps for Access to the Cardeck from Upper Deck Fore

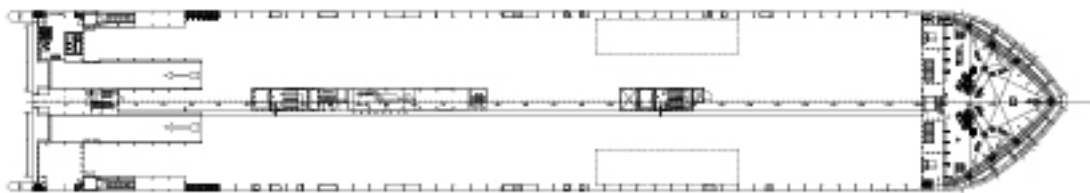
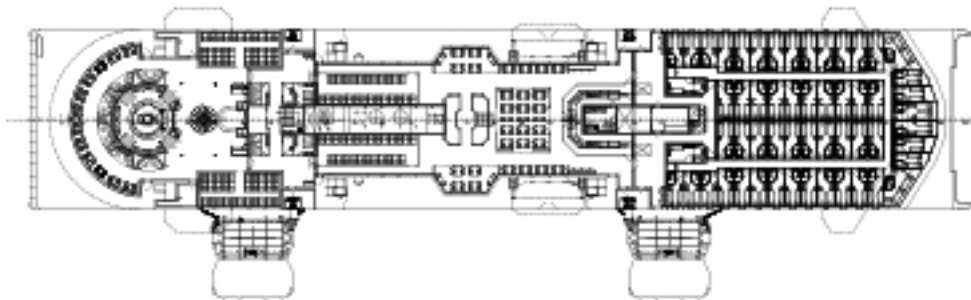
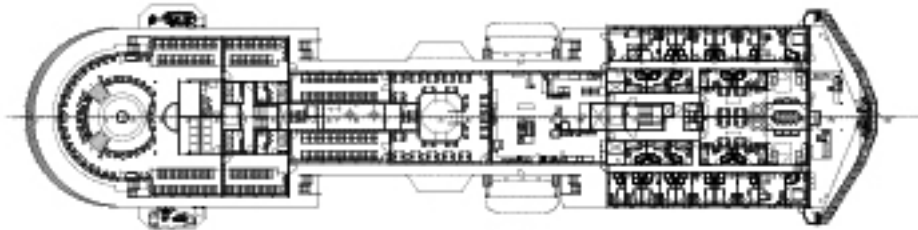
Tanks Capacity:

Fuel-Oil Capacity: 621 m³ / *Diesel-Oil Capacity:* 92 m³ / *Lub. Oil Capacity:* 45 m³
Fresh Water Capacity: 93 m³ / *Ballast Water Capacity:* 1695 m³

Hull Nº:
1626

Name:
VOLCAN DE TIMANFAYA

Built:
2005



VIGO/SPAIN

T: +34 986 213 297

astillero@hjbarreras.es

www.hjbarreras.es



STAR: new-concept ferry for Estonia to Finland route

Shipbuilder: **Aker Yards Oy (Helsinki yard), Finland**
 Vessel's name: **Star**
 Hull number: **1356**
 IMO number: **9364722**
 Owner/operator: **Tallink Group, Estonia**
 Designer: **Aker Yards Oy, Finland**
 Flag: **Estonia**
 Total number of sister ships already completed: **Ni**
 Total number of sister ships still on order: **1 option**

ESTONIAN ferry group Tallink's recent acquisition of a number of its competitors trading in the Gulf of Finland and Baltic Sea areas, has made this, still comparatively young, company, the largest operator in the region, with its rapid expansion marked by a continuing newbuilding programme of ro-pax and cruise ferries, designed for service on routes linking Estonia with Finland and Sweden; Sweden with Latvia and Finland, and Finland with Germany. The first newbuilding was *Romanika*, presented in *Significant Ships of 2002*.

Latest entry into the fleet, *Star*, introduces a new dimension into these operations by providing a high-speed 'shuttle' connection between the Finnish and Estonian capitals, Helsinki and Tallinn, which completes the 80km journey in only two hours, giving rise to the claim that she is 'the fastest conventional ferry yet built for operation over such a short distance'. An important feature of the specification is the inclusion of Finnish Ice Class 1A requirements, which means that the vessel will be able to operate this unique service all year round.

Star will make three departures daily from each of the two termini, travelling at a service speed of 27knots, derived from a conventional machinery installation based on four MaK 12M43C main engines manufactured by Caterpillar Motoren, Rostock. Each develops 12,000kW at 514rev/min, and they are connected in pairs, through a twin input/single output gearbox, to a Wärtsilä CP propeller running at 144.3rev/min.

Wärtsilä also supplied three thrusters: two with an output of 1500kW installed at the bow; and one of 1000kW positioned aft. A further aid to manoeuvring comes from two Becker hinged-flap rudders, whilst passenger comfort on the relatively short journey is assisted by fitting a set of Blohm +Voss Industries retractable fin stabilisers. Electrical services are supplied from three 1688kVA Wärtsilä/A van Kaick diesel-alternator sets.

Although specifically intended for operation on a daytime, short sea shuttle run, *Staris* fully equipped to offer an alternative service of short, overnight cruises out of Tallinn if required, and for this purpose 64 x 4-berth outside, and 65 x 4-berth inside cabins, plus

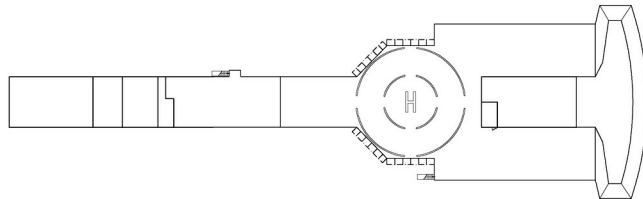
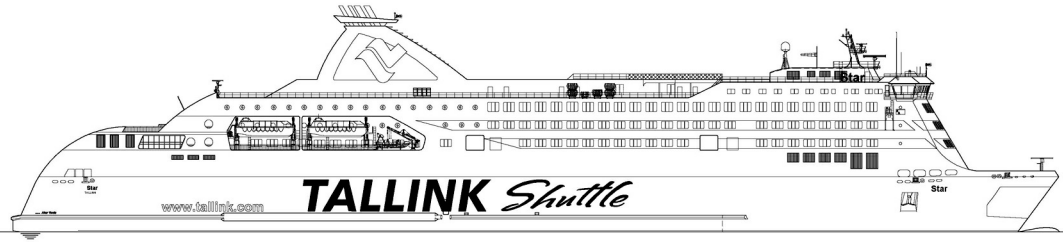
two x 2-berth handicapped-traveller cabins have been provided as modular units, complete with en-suite facilities, by subcontractors Kaefer and Parmanne. In all, 1900 passengers and 100 crew can be carried, making use of a pizzeria, three restaurants, pub, business lounge, observation lounge, perfume shop and a 1500m² market area, on decks 7, 8, and 9 of the 11-deck hull whilst onboard. Four 150 person lifeboats and four MES chutes cover lifesaving requirements.

Star also provides fast transit for motor vehicles, carried on the main and upper decks, with access from shore over a 18m x 4.7m bow ramp; and a 11m x 18m stern ramp, both supplied by TTS. A 49m x 6m hoistable internal ramp allows movement between the decks. With over 2000 lane metres of vehicle deck space available, up to 120 trucks or freight units, or 450 private cars can be loaded.

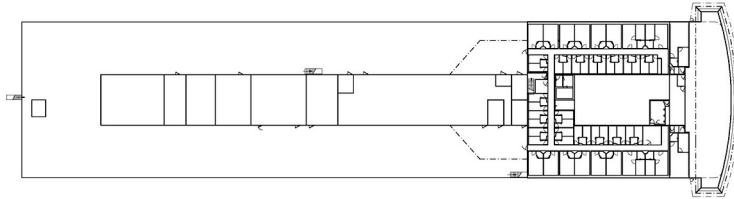
TECHNICAL PARTICULARS

Length, oa 186.00m
 Length, bp 170.00m
 Breadth, moulded 27.70m
 Depth, moulded
 to main deck (No 3) 9.50m
 to upper deck (No 5) 20.90m
 Draught
 design 6.50m
 scantling 6.75m
 Gross 36,250gt
 Deadweight, design 4700dwt
 Speed, service 27knots
 Bunkers
 heavy oil 975m³
 diesel oil 170m³
 Water ballast 3250m³
 Fuel consumption, main engines only 195tonnes/day
 Classification Bureau Veritas 1 + Hull Ro-Ro, Passenger Ship, + MACH, AUT, UMS, SYS-NEQ-1, Finnish Ice Class 1A
 Percentage of high-tensile steel used in construction 28%
 Roll stabilisation equipment Blohm + Voss Industries fins
 Main engines
 Design MaK
 Model 12M43C
 Number 4
 Manufacturer Caterpillar Motoren
 Type of fuel used HFO and MDO
 Output 4 x 12,000kW/514rev/min
 Gearboxes
 Make Fender
 Model GVLO 1300
 Number 2 x twin input/single output
 Output speed 144.3rev/min
 Propellers
 Material Stainless steel
 Designer/manufacturer Wärtsilä
 Number 2

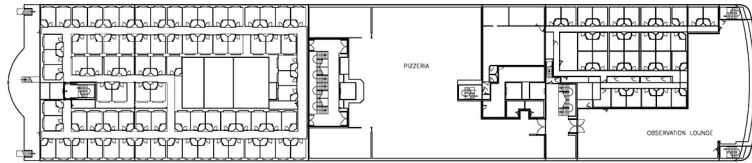
Pitch Controllable
 Diameter 5300mm
 Speed 144.3rev/min
 Diesel-driven alternators
 Number 3
 Engine make/type Wärtsilä/BL20
 Type of fuel used HFO and MDO
 Output/speed 3 x 1420kW/1000rev/min
 Alternator make/type A van Kaick/DSG 59 K1-6W
 Output/speed 3 x 1688kVA/1000rev/min
 Boilers
 Number 2
 Type CHB 5000
 Make Aalborg Industries
 Output 2 x 5000kg/h
 Vehicles
 Number of vehicle decks 2
 Total lane length 2010m
 Total cars 450
 Total freight units 120
 Doors/ramps
 Number/type 1 x stern/1 x bow door ramp, 1 x internal ramp
 Designer TTS Ships Equipment
 Complement
 Officers 17
 Crew 83
 Passengers
 Total 1900
 Accommodated in cabins 520
 Number of cabins 131
 Bow thrusters
 Make Wärtsilä
 Number/type 2 x CT 225
 Output 2 x 1500kW
 Stern thruster
 Make Wärtsilä
 Number/type 1 x CT 200
 Output 1000kW
 Bridge control system
 Make Kelvin Hughes
 Type Manta
 One man operation No
 Fire detection system Consilium
 Fire extinguishing systems
 Vehicle spaces Novenco drencher
 Accommodation Novenco sprinkler
 Engine room Minimax CO₂
 Radars 3 x Kelvin Hughes Manta
 Integrated bridge system Kelvin Hughes Manta
 Waste disposal plant
 Waste compactors 2 x Kapasity 103
 Sewage plan 1 x Evac Bio Unit MSP VIII
 Contract date 1 August 2005
 Launch/float-out date 23 November 2006
 Delivery date 10 April 2007



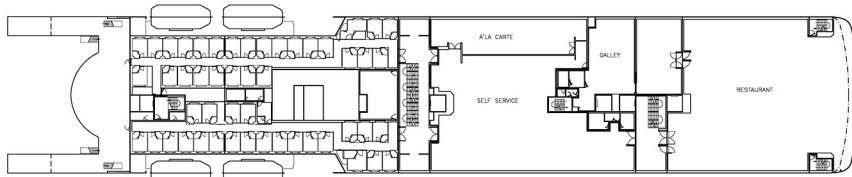
DECK 11



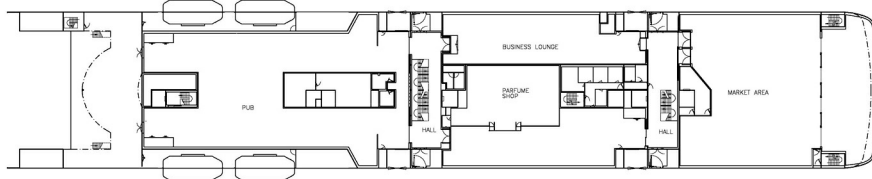
DECK 10



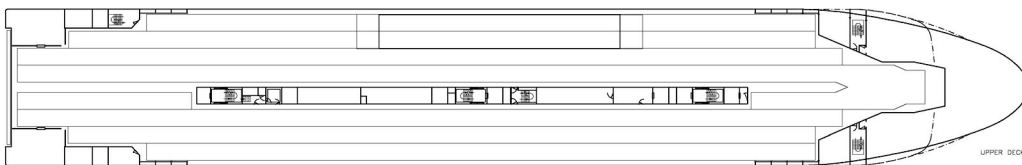
DECK 9



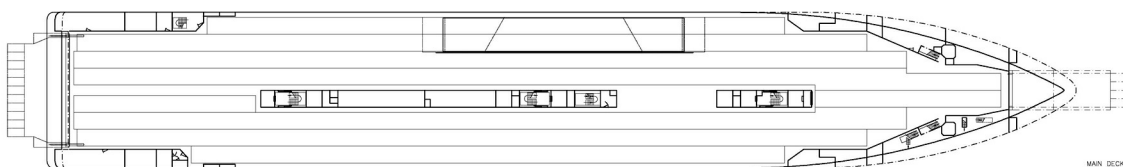
DECK 8



DECK 7



UPPER DECK (5)



MAIN DECK (5)



SILVER PRINCESS: advanced ro-pax from Japan

Shipbuilder: **Mitsubishi Heavy Industries Ltd**
 Vessel's name: **Silver Princess**
 Hull No: **1158**
 Owner/operator: **Kawasaki Kinkai Kisen Kaisya Ltd**
 Country: **Japan**
 Designer: **Mitsubishi Heavy Industries Ltd**
 Country: **Japan**
 Model test establishment used: **MHI Nagasaki R&D Centre, Japan**
 Flag: **Japan (Hachinohe)**
 IMO number: **9597616**
 Total number of sister ships already completed (excluding ship presented): **nil**
 Total number of sister ships still on order: **nil**

SILVER Princess is a ro-pax ferry, for Kawasaki Kinkai Kisen Kaisya Ltd that services the Tomakomai to Hachinohe route. The vessel was designed and built at the Shimonoseki Shipyard & Machinery Works of Mitsubishi Heavy Industries, Ltd. (MHI), and delivered to the owner on 5 April.

The vessel which is a one off design for the owners, has been further optimised with the hull form of *Silver Princess* enhanced through model tank testing which, was used to significantly improve the fuel oil consumption.

The propulsion system installed on the vessel is a combination of two main engines and two controllable pitch propellers driven through two reduction gears. The latest medium speed diesel engines give a service speed of 20.5knots at 85% power. The highly skewed controllable pitch propellers contribute to the reduction in the propeller surface force.

In addition to the above, the ship is equipped with two bow thrusters manufactured by Kawasaki Heavy Industries to enable smooth manoeuvring in harbour. A pair of fin stabilisers have been installed in order to reduce the rolling of the vessel and to increase the comfort level during the voyage.

The maximum loading capacity of vehicles onboard is 92 trailers/trucks and 30 passenger cars. Two outboard ramps on Deck-3 and three inboard ramp ways are arranged to give better loading/unloading at the quays on the vessel's regular route.

There are various cabin types onboard for passengers, such as deluxe class, first class and economy class cabins. The passengers can enjoy the time onboard at various public spaces such as the restaurant, grand bath with ocean view, entrance, lobby, kid's room and other areas. Furthermore, the Japanese barrier free rule has been applied to the vessel, so that all passengers including the handicapped can move about the vessel safely and enjoy the

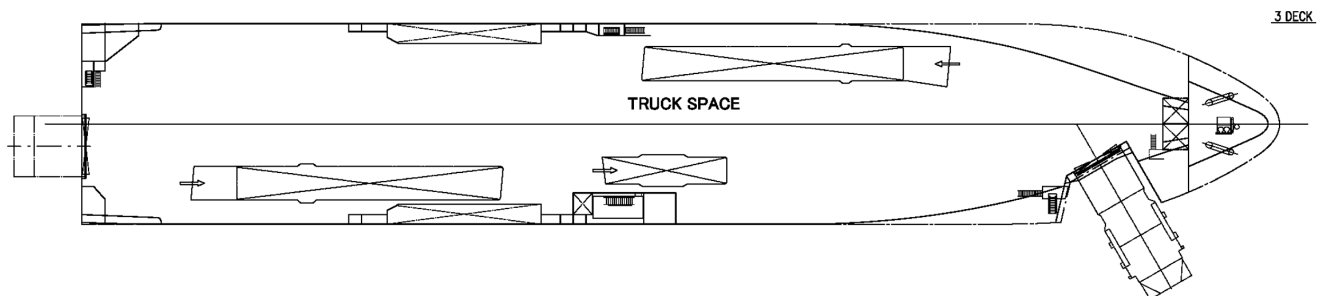
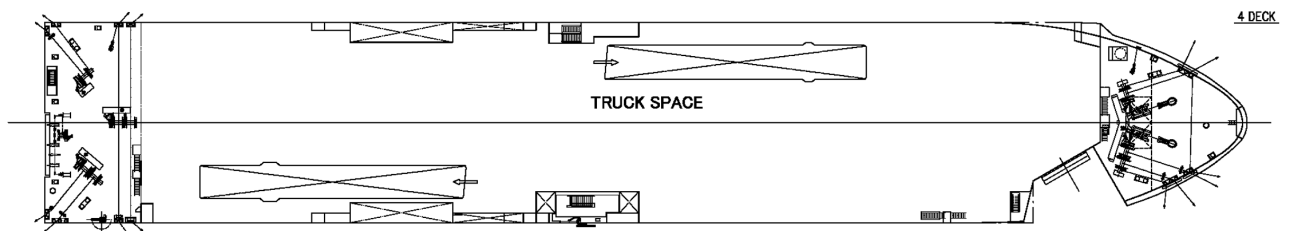
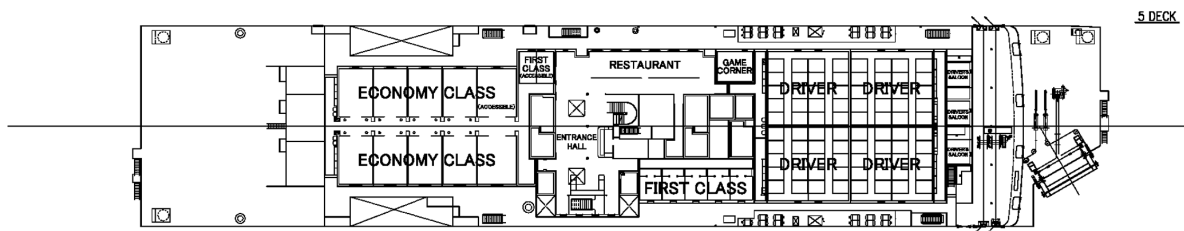
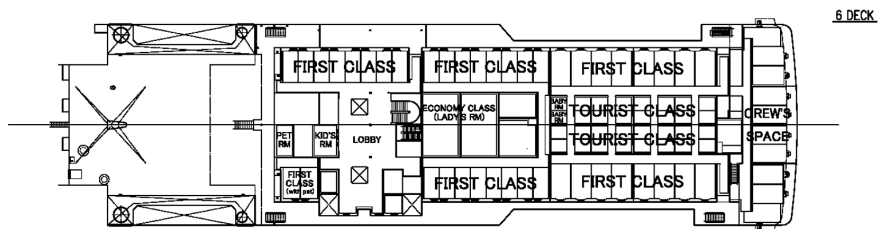
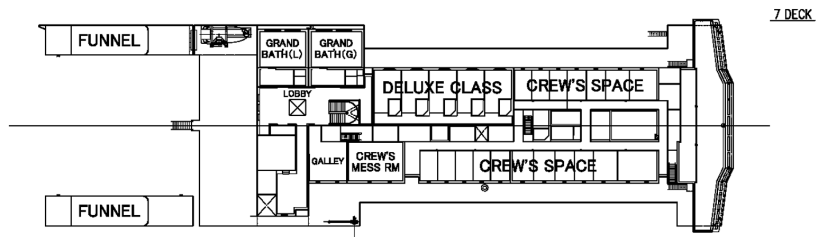
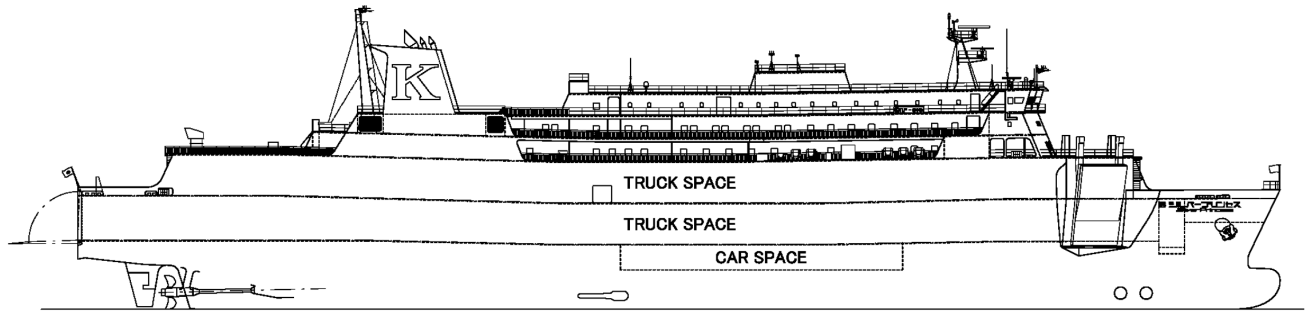
facilities onboard. Two elevators are fitted allowing passenger's to board and disembark and to move around the vessel's accommodation area.

TECHNICAL PARTICULARS

Length oa: 150.00m
 Length bp: 137.50m
 Breadth moulded: 25.00m
 Depth moulded
 To main deck: 8.00m
 To upper deck: 13.15m
 Draught
 Scantling: 5.85m
 Design: 5.70m
 Gross: 10,536gt
 Deadweight
 Design: 4,315dwt
 Scantling: 4,724dwt
 Speed, service: 20.5knots
 Bunkers
 Heavy oil: 612.3m³
 Diesel oil: 124.8m³
 Water ballast: 3,056.2m³
 Daily fuel consumption
 Main engine only: 55.1tonnes/day
 Main engine
 Design: S.E.M.T – Pielstick
 Model: 12PC2-6B
 Manufacturer: JFE Engineering Corporation
 Number: 2
 Type of fuel: HFO, MDO
 Output of each engine: 7,200kW
 Gearboxes
 Make: Kitachi Nico Transmission Co., Ltd
 Model: MGP1843H50
 Number: 2
 Propellers
 Material: ALB3
 Designer/manufacturer: Kawasaki Heavy Industries
 Number: 2
 Fixed/controllable pitch: Controllable
 Diameter: 4.2m
 Main-engine driven alternators
 Number: 2
 Make/type: Nishiba Electric Co., Ltd
 Diesel-driven alternators
 Number: 3
 Engine make/type: Daihatsu Diesel MFG. Co. Ltd/ 5DK-20e
 Type of fuel: HFO, MDO

Output/speed of each set: 900rpm
 Boilers
 Number: 1
 Make: Muira Co., Ltd
 Output, each boiler: 3,000kg/h
 Mooring equipment
 Number: 4
 Make: Manabe Zoki Co., Ltd
 Type: Electric-hydraulic
 Special lifesaving equipment
 Number of each and capacity: MES-2
 Make: Fujikura Rubber Ltd
 Type: FSMES-160 N
 Vertical or sloping chutes: Vertical
 Vehicles
 Number of vehicle decks: 3
 Total cars: 30
 Total freight: 92
 Doors/ramps/lifts/movable car decks
 Number of each: 2 x ramps, 2 x movable car decks
 Ballast control system
 Make: NYK Trading Corporation
 Complement
 Officers: 9
 Crew: 11
 Passengers
 Total: 900
 Number of cabins: 176
 Stern appendages/ special rudders: Mariner
 Bow thruster
 Make: Kawasaki Heavy Industries
 Number: 2
 Bridge control system
 Make: Nabtesco
 Type: electric
 Fire detection system
 Make: Nippon Hakuyo Electronics
 Type: Smoke detector type & Temperature type
 Fire extinguishing systems
 Engine room: Air Water Safety Service/ CO₂
 Vehicle spaces: Nohmi Bosai Ltd/ sprinkler
 Cabins/public spaces: Yamato Protec/ Portable
 Radars
 Number: 3
 Make: JRC
 Contract date: 26 March 2010
 Launch/float-out date: 11 November 2011
 Delivery date: 5 April 2012

SILVER PRINCESS





STAVANGERFJORD: LNG ferry for Norway

Shipbuilder: **Bergen Group Fosen**
 Vessel's name: **Stavangerfjord**
 Hull No: **87**
 Owner/operator: **Fjord Line**
 Country: **Norway**
 Designer: **Bergen Group Fosen**
 Country: **Norway**
 Model test establishment used: **Marintek**
 Flag: **Denmark**
 IMO number: **9586605**
 Total number of sister ships already completed
 (excluding ship presented): **nil**
 Total number of sister ships still on order: **1**

NORWAY is taking the lead when it comes to environmental shipping and *Stavangerfjord*, is another example of this initiative. The vessel was delivered to Fjord Line in July after some delay due to further testing of its LNG powered engines. *Stavangerfjord* is the first of a series of two vessels constructed at Bergen Group, Norway with the initial steel work carried out at Stocznia Gdansk shipyard. The second in the series *Bergensfjord* was launched just after *Stavangerfjord*.

Stavangerfjord is one of the most environmentally friendly passenger ships in international operation, powered by LNG enabling it to eliminate its SOx emissions as well as reducing the CO₂ emissions by 23%, NOx emissions by 92% and particulate emissions by 98%, compared to ships powered by traditional heavy fuel oil. The waste heat recovery system (WHRS) that has also been installed provides both electricity from a steam generator and heating from warm water in the accommodation areas.

Both the vessels are powered by four Bergen gas engines individually rated at 5,600kW, driving Promas integrated rudder and propeller propulsion systems for optimal fuel efficiency. Originally the ferries were ordered with diesel engines, but Fjord Line made the decision to replace these with Bergen BV35:40P12G gas engines, to pre-empt the emission regulations for emission control areas (ECAs) when they come into effect that will limit NOx and SOx emissions in those areas.

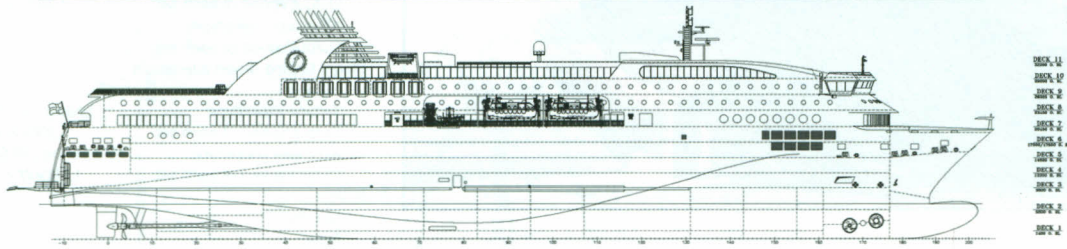
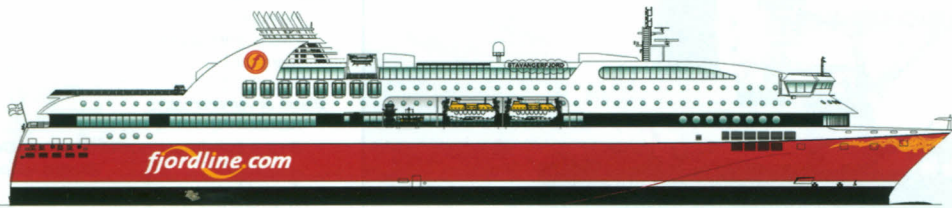
Each ship has 306 cabins, many of which will be suites, and can accommodate 1,500 passengers. The cargo decks have a total lane capacity of 1,350m², which has capacity for 600 vehicles or alternately a smaller number of vehicles in combination with larger

trucks and cargo. *Stavangerfjord* will service the routes between Hirtshal, Denmark and Stavanger, Norway and Hirtshal and Langesund, Norway.

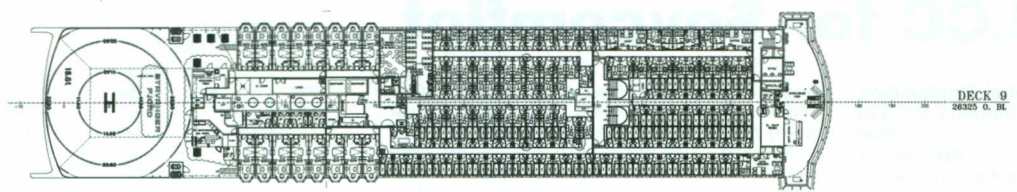
TECHNICAL PARTICULARS

Length oa: 170.00m
 Length bp: 148.00m
 Breadth moulded: 27.50m
 Depth moulded
 To main deck: 9.30m
 Draught
 Scantling: 6.50m
 Design: 6.35m
 Gross: 31,678gt
 Displacement: 15,712tonnes
 Lightweight: 12,243tonnes
 Deadweight
 Design: 36,200dwt
 Block co-efficient: 0.5977
 Speed, service: 21.5knots
 Bunkers
 LNG: 600m³
 Water ballast: 1,508m³
 Classification society and notations: DNV *1A1, ICE 1B, Car Ferry A, E0, Gas Fuelled, CLEAN, NAUT-AW, WBR, MCDK, TMON, F-M, COMF V(2)
 Heel control equipment: Frank Mohn
 Main engine
 Make: B35: 4 OV 12 PG
 Manufacturer: Rolls-Royce Marine
 Number: 4
 Type of fuel: LNG
 Output of each engine: 6,400kW
 Gearboxes
 Make: MAN Diesel & Turbo
 Model: 888 783/100
 Number: 2
 Propeller
 Designer/manufacture: Rolls-Royce
 Number: 2
 Fixed/controllable pitch: Controllable
 Diameter: 4.7m
 Shaft generators
 Number: 2
 Make/type: Rolls-Royce/ Marelli
 Output/speed of each set: 1,850kW

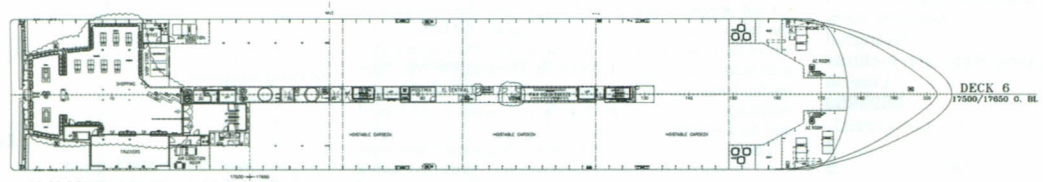
Boilers
 Number: 1
 Type: Mission
 Make: Aalborg Industries
 Capacity: 3.8tonnes/h
 Other cranes
 Number: 1
 Make: Fuchs Fördertechnik
 Type: Telescopic
 Tasks: Provisions
 Performance: 7.5tonnes
 Mooring equipment
 Number: 8
 Make: Rolls-Royce Marine
 Type: MW160E
 Special lifesaving equipment
 Number of each and capacity: 4 x 151 persons
 6 x 153 persons
 4 x 51 persons
 Make: Fassmer/ Viking Lifesaving
 Hatch covers
 Manufacturer: TTS Marine
 Vehicles
 Total lane length: 1,350m
 Total cars: 600
 Doors/ramps/lifts/movable car decks
 Type: Movable car deck (Deck 6)
 Designer: TTS Marine
 Ballast control system
 Make: Panasia
 Water ballast treatment system
 Make: Panasia
 Complement
 Crew: approx. 100
 Passengers
 Total: 1,200/1,500
 Number of cabins: 303
 Bow thrusters
 Make: Rolls-Royce
 Number: 2
 Output: 1,600kW
 Fire detection system
 Make: Honeywell Life Safety
 Contract date: 16 March 2010
 Launch/float-out date: 12 April 2012
 Delivery date: 4 July 2013



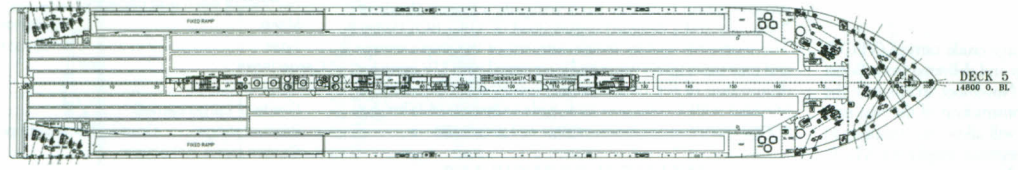
- DECK 11
- DECK 10
- DECK 9
- DECK 8
- DECK 7
- DECK 6
- DECK 5
- DECK 4
- DECK 3
- DECK 2
- DECK 1



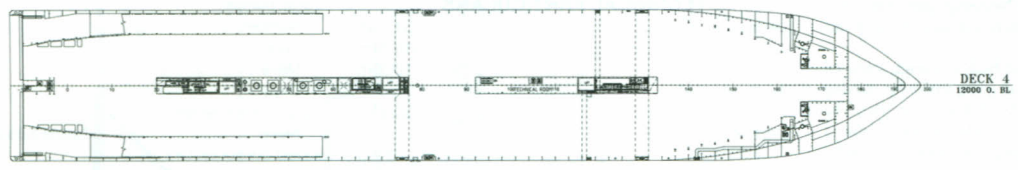
DECK 9
26325 O. BL



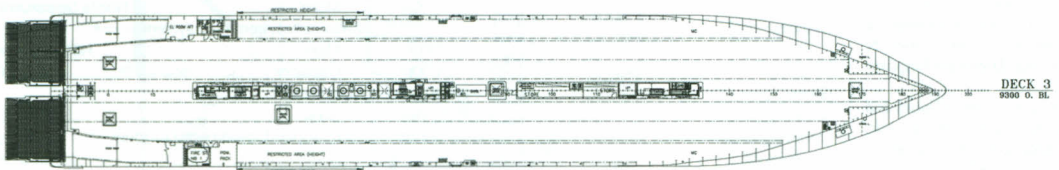
DECK 6
17500/17650 O. BL



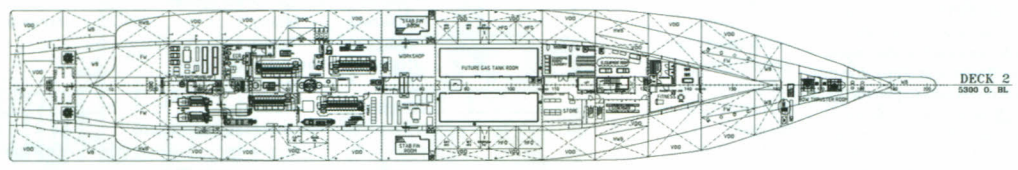
DECK 5
14600 O. BL



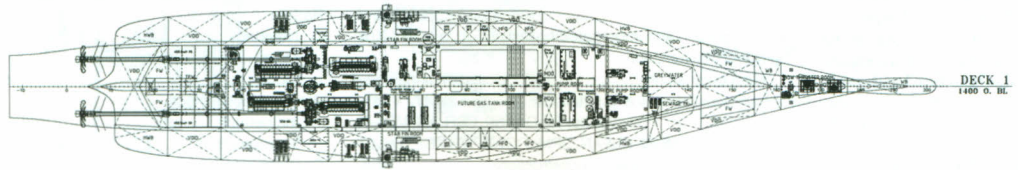
DECK 4
13500 O. BL



DECK 3
9300 O. BL



DECK 2
5300 O. BL



DECK 1
1400 O. BL



VIKING GRACE: Largest LNG ferry for Finland

Shipbuilder:..... **STX Finland, Turku**
 Vessel's name:..... **Viking Grace**
 Hull No:..... **1376**
 Owner/operator:..... **Viking Line**
 Country:..... **Finland**
 Designer:..... **STX Turku**
 Country:..... **Finland**
 Model test establishment used:..... **MARIN**
 Flag:..... **Finnish**
 IMO number:..... **9606900**
 Total number of sister ships already completed (excluding ship presented):..... **nil**
 Total number of sister ships still on order:..... **nil**

VIKING Grace heralded a new era for passenger ferries when it was launched. Deemed as one of the most advanced vessels of the time due to the use of LNG to power the vessel, Viking Grace also made the record books because the vessel is one of the longest LNG powered vessels ever constructed.

Viking Grace, built by STX Finland, has replaced Isabella on the Turku-Stockholm route, the shortest connection between Sweden and Finland. The route is demanding for the ships due to the tight schedule with as little as one hour harbour time for unloading and loading passengers and ro-ro cargo.

The ferry's main machinery is based on a cruise ship-type power plant principle, consisting of four 8-cylinder dual fuel engines driving generating sets. The power plant's principle optimal engine load on its complex route has operating speeds varying from 8knots to 15 and up to 22knots in addition to the high degree of safety and redundancy.

The engine runs off LNG, which has been pitched as the fuel of the future due to its ability to reduce a ship's emissions dramatically. The fuel in Viking Grace is stored in the aft end of the ship, on the open deck in two 200m³ LNG-tanks.

The ship's propulsion consists of two five-bladed stainless steel fixed-pitch propellers with modern high-lift flap rudders, which also fulfils the requirements of Finnish-Swedish Ice class 1A Super and Lloyd's Register's highest passenger comfort rating. For better harbour manoeuvring three thrusters have installed, one aft and two forward.

The latest energy-saving technologies have been applied in the ship's design: various energy management systems, LEDs used in lighting, elevators with energy recovery, high efficiency pumps and fans, just to name a few. Excess heat produced by machinery during the voyage is stored in specific heat accumulator tanks and the stored heat is used during the time in port for pre-heating the air-conditioned air. The cold

from the LNG is also used for cooling the air-conditioned air in summertime.

The public spaces are arranged on the uppermost decks to provide the most spectacular scenery as well as direct access to the outer decks. Dining facilities are located forward and entertainment facilities aft. The venues are organised around service hubs, located internally on each deck for easy and efficient access. The hubs are supported from vertically connected logistics centres, located below the ro-ro decks.

Passenger cabin areas extend from deck 5 to deck 9. A large variety of cabins are offered, including bigger cabins in the forward section accommodating cruise ship-like double beds. Crew cabins, which are required to have windows, are located sides of the private car garage on deck 5 and on life boat decks 6 and 7 with restricted view.

TECHNICAL PARTICULARS

Length oa:..... 218.50m
 Length bp:..... 200.00m
 Breadth moulded:..... 31.80m
 Depth moulded
 To main deck:..... 9.80m
 Draught
 Scantling:..... 7.00m
 Design:..... 6.80m
 Gross:..... 57,565gt
 Deadweight
 Design:..... 50,300dwt
 Scantling:..... 60,800dwt
 Speed, service:..... 22knots
 Bunkers
 LNG:..... 2 x 200m³
 Diesel oil:..... MGO: 178m³ HFO: 470m³
 Water ballast:..... 1,450m³ + heeling 670m³
 Daily fuel consumption
 LNG:..... 45-48tonnes/day
 Pilot fuel (MGO):..... 0.5tonnes/day
 Classification society and notations:..... Lloyd's Register of Shipping + 100A1 Passenger and vehicle ferry, IWS, ICE, 1AS, +LMC, UMS, IBS, PCAC12, PSMR*, Green passport, Movable car decks, GF
 Heel control equipment:..... Hoppe Bordmesstechnik GmbH
 Roll stabilisation equipment:..... Blohm & Voss, fin stabilisers, Simplex-compact s600-9m²
 Main engines
 Model:..... 8L50DF
 Manufacturer:..... Wärtsilä
 Number:..... 4
 Type of fuel:..... LNG/NG backup fuel MGO
 Output of each engine:..... 7,400kW

Exhaust gas system
 Manufacturer:..... Wärtsilä
 Model:..... Compact silencer system (CSS)
 Number:..... 4
 Type:..... Optimal noise attenuation, less than 50dB at 100m
 Propulsion motors
 Make:..... ABB
 Model:..... AMZ 1600 2XW 12LSB
 Number:..... 2
 Output speed:..... 10.5MW x 128rpm
 Propellers
 Designer/manufacturer:..... Wärtsilä
 Material:..... Stainless steel
 Number:..... 2
 Fixed/controllable pitch:..... Fixed
 Diameter:..... 5.2m
 Speed:..... 130rpm
 Special adaptations:..... 5 bladed built up propeller
 Main generators
 Number:..... 4
 Make/type:..... ABB/AMG 1120 ME 12LSE
 Output/speed of each set:..... 8.191 x 500rpm
 LNG tanks & related equipment
 Manufacturer/type:..... Wärtsilä LNGPac
 Capacity:..... 2 x 200m³
 Boilers
 Number:..... 2 x dual fuel
 Type:..... FMB-VM-7/7
 Make:..... Saacke
 Output, each boiler:..... 7,000kg/h at 7bar
 Type of fuel:..... LNG/NG/MGO
 Mooring equipment
 Number:..... 2 x combined anchor windlasses/ self tensioning mooring winches
 6 x 250kN self tensioning mooring winches
 Make/type:..... NDM/Electrical
 Special lifesaving equipment
 Number of each and capacity: 2 x 316, 2 x 237, spare rafts
 4pcs 158 persons, 4 for 50 persons
 Make/type:..... RFD Beaufort/Marine Ark MK 2 MES
 Hatch covers
 Manufacturer/type:..... TTS/2 x on deck 3
 Vehicles
 Number of vehicle decks:..... 2 x fixed, 1 x movable
 Total lane length:..... 1,275
 Total cars:..... 300
 Doors/ramps/lifts/movable car decks
 Number of each:..... 1 x Bow doors, 1 x bow ramp/door, 1 x stern ramp/door, 1 x hoistable car deck, 2 x provisions lifts, 1 x cargo lift
 Designer/manufacturer:..... TTS
 Lifts
 Number of each:..... 14
 Manufacturer:..... Kone
 Passengers
 Total:..... 2,800
 Number of cabins:..... 880
 Percentage/number onboard:..... 34%
 Rudders
 Make:..... Van der Velden Barkemeyer
 Rudder type:..... TTA 35057-23/20
 Rudder area:..... 20m²
 Bow thruster
 Make:..... Wärtsilä
 Number:..... 2
 Output:..... 2,300kW
 Type:..... CT2755H
 Propeller diameter:..... 2.75m
 Propeller speed:..... 243rpm
 Stern thruster
 Make:..... Wärtsilä
 Number:..... 1
 Output:..... 1,500kW
 Type:..... CT225H
 Propeller Diameter:..... 2.25m
 Propeller speed:..... 243rpm
 Bridge control system
 Make:..... L3 SAM Electronics
 Type:..... NACOS Platinum
 One-man operation:..... Yes
 Integrated automation system
 Make/type:..... L3 SAM Electronics Valmatic Platinum
 Fire detection system
 Make/type:..... Autronica Autromaster 5000
 Fire extinguishing system
 Make/Type:..... Marioff/Hi-Fog
 Radar
 Number:..... 4
 Make/model:..... L3 SAM Electronics NACOS Platinum
 Contract date:..... 25 November 2010
 Launch/float-out date:..... 17 August 2012
 Delivery date:..... 10 January 2013

VIKING GRACE

