

 <b>PETROBRAS</b>	TECHNICAL SPECIFICATION		Nº: <b>I-PT-4880.00-7109-200-CZ1-001</b>
	CLIENT:	LOG/TM/ON	SHEET: 1 of 25
	JOB:	TP 25 – PRODUCT CARRIERS 15600 DWT	-
	AREA:	PETROBRAS FLEET	IN-4880-23-001
TITLE: <b>TECHNICAL PROPOSAL FOR SWITCHBOARDS</b>		LOG/PL/EGE	
			INTERNAL
 <b>MARENNOVA</b>	BUILDER: CONSORCIO ECOVIX / MACLAREN	CONTRACT NUMBER: 7000.0130000.25.2	
	TECHNICAL RESPONSIBLE: MARCELO DELANO	CREA NUMBER: 2006118561	KONGSBERG NUMBER: N/A

## INDEX OF REVISION

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	ORIGINAL ISSUE

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E
DATE	22/10/2025					
EXECUTION	DANIEL LARANJO					
CHECK	DAVI PEGADO					
APPROVAL	MARCELO DELANO					

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## 1. Revision History

Rev.	Date	Description of Change	By whom
0	Aug 23, 2024	First issue	RMCF
2	Jun 02, 2025	Updated according to Building specification (9)	ERO
3	Jun 19, 2025	Updated according to Building specification (9) and after tech meetings with yard. Small cleaning and info.	LBR
4	July 2, 2025	Updated class notation	LBR
5	Sept 16, 2025	Updated voltage level, added future HVSC description	ERO
6	Sept 22, 2025	Added system studies	ERO
7	Oct 09, 2025	Added deviation list	ERO

## 2. Comments to Quotation

09.10.2025

Added a deviation list in chapter 2.1

22.09.2025

Added description of system studies that will be delivered.

16.09.2025

Updated voltage levels to 450V, 220V. Added description for HVSC system, not included in the delivery.

09.09.2025

Updated voltage levels to 450V/220V.

02.07.2025

Updated class notation.

### 2.1 Deviations

No.	Customer technical requirement	Description of Deviation
01	The MSB shall be equipped with optical arc detection sensors to trip the busbar's power circuit breakers.	Not included, typically not used for this vessel type. Can be included on request, at additional cost.
02	The automatic and manual controls shall be located in the MSB synchronization column	Manual control of sync and load is performed in each generator panel via the HMI touch panel.
03	The front and rear doors of electrical panels shall be fitted with handrails made of insulating material along the entire length of the panel	This type of switchboard has rear mounted busbars, hence there are no doors on the rear side.
04	Power quality monitoring shall be included for the main busbars	Not included, typically not used for this vessel type. Can be included on request, at additional cost.

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05	The switchboards shall be designed for free standing mounting on a common base frame. Each cubicle shall consist of a framework built up of zinc plated squared tubes	The frame of the switchboard is built up of painted steel profiles.		
06	The main busbar should preferably be located at the top of the panel, without splices, silver plated at the contact points	The contact points are not silver plated. The switchboard uses a purpose specific paste at the connection points		
07	The busbars shall be made of electrolytic copper, insulated (sheathed) and fitted with silver plated contacts/terminations.	Busbars are not sheathed; they are located in a separate busbar compartment in the rear part of the switchboard.		
08	In front of panel shall be mounted control equipment for the generator breaker, etc.:	Manual control of sync and load is performed in each generator panel via the HMI touch panel.		
09	Main bus instrument. Mimic diagram in front including: <ul style="list-style-type: none"> <li>• Running indicator emergency diesel</li> <li>• Emergency switchboard supplied from emergency generator</li> <li>• Emergency switchboard supplied from main switchboard</li> </ul>	There is no mimic diagram in one section, information is available from the relevant section. Overall mimic is available from PMS operator station.		
<h3>3. Energy System description</h3> <h4>3.1 Kongsberg AC Solution</h4> <p>The AC Solution is an integrated power electric system in which the main power generation is carried out by means of synchronous AC generators connected directly to an AC switchboard.</p> <p>The AC Solution comprises generators, switchgear, variable speed drives and motors for propulsion, all controlled by Kongsberg power- and energy management systems.</p> <p>Integration between the different main elements of the power system is based on standardized interfaces developed through extensive operational experience, focusing on safety, efficiency and flexibility.</p> <p>A high level of flexibility is achieved by utilizing the main elements of the power system in various combinations. Pre-defined power system modes can be defined to meet operational requirements in different vessel operating modes.</p> <p>Power Management System functions are described in further detail in “Section 3 – Instrument System”</p>				

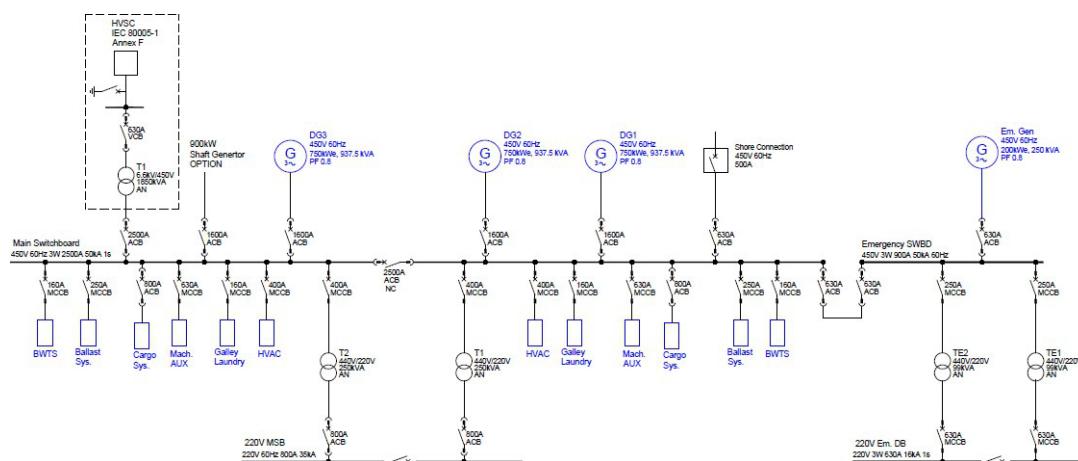
### 3.2 System Topology

#### 3.2.1 Power System Topology

Electric power generation consists of three generator sets connected to a 450V main switchboard. The rated system frequency is 60Hz. Power is distributed to main consumers and transformers from the main switchboard.

A bus-tie breaker is installed and is normally closed. A low voltage shore connection system is included, the connection is synchronized towards the generators for transfer of load without going through black-out.

Power is distributed from main switchboard to large consumer groups like HVAC and Cargo, and to smaller power consumers through transformers.

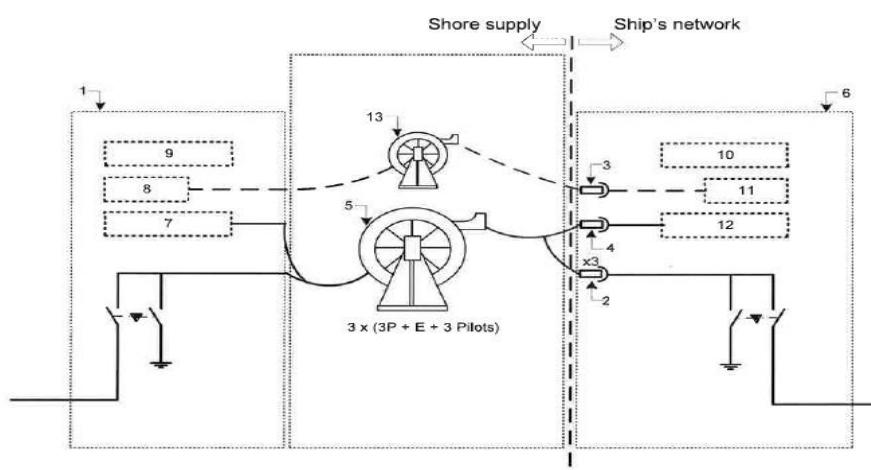


There are spare breakers for future installation of High voltage shore connection and shaft generator system in the main switchboard.

An emergency generator connects to an emergency switchboard to power all consumers defined for emergency operation. Under normal operation conditions, the emergency switchboard is powered from the main switchboard.

#### 3.2.2 Hight Voltage Shore Connection system (OPTION)

The high voltage shore connection system is designed to comply with IEC 80005-1, Annex F For tankers is applied for this application. See sketch below for general connection system. The sketch below illustrates the system topology.



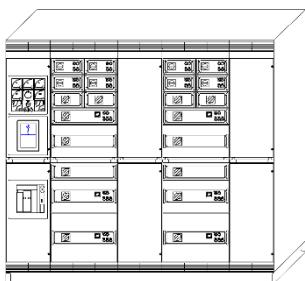
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## 4. Scope of Supply

### 4.1 Kongsberg Low Voltage Switchboards

#### 4.1.1 General Specification

The low voltage switchgear and control gear assembly is designed by Kongsberg Maritime. It's a unique enclosure solution, where a range of different cubicles can be assembled based on few standard components, joined together. This gives high flexibility, and a robust design tailor made for the marine industry. The switchboard has been designed according to 61439-1/2 and IEC60092-302.



#### 4.1.1.1 Recommended Switchgear installation

Front: Minimum 1200 mm free space in front is required to have escape route with doors open. Side: Minimum 250 mm free space on each side to open door more than 90 degrees.

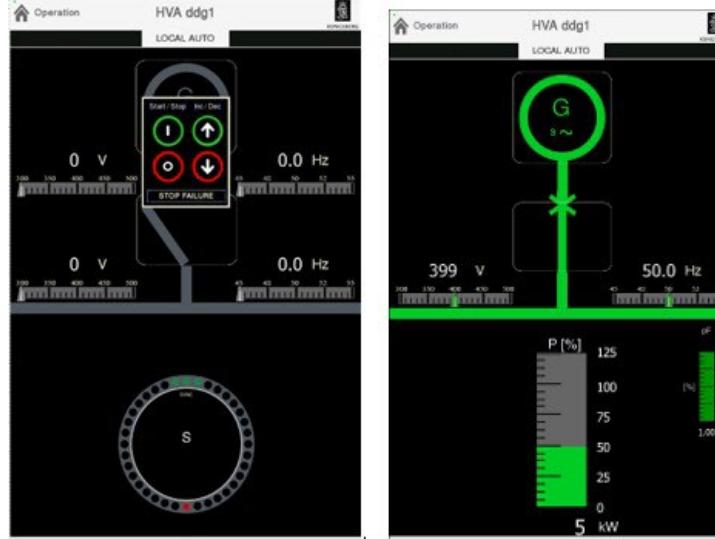
Rear: Minimum 500 mm free space to have access for easy installation and maintenance. Top: Minimum 100 mm and minimum 300 mm where ARC flaps on top are required.

Environment: Switchgears must be placed in clean and well-ventilated locations. Cable entry: Bottom.

#### 4.1.2 General incomer W. digital Layer – ACB and touchscreen functions

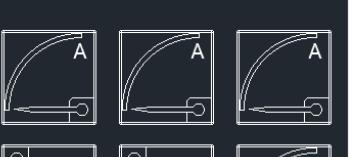
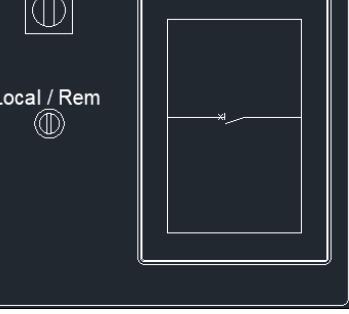
Included is Kongsberg K-Power Digital Layer with fast measurement, protection, and functions. The plug-and-play interface to K-Chief PMS/EMS is done by Modbus TCP. Therefore, no additional transducers are installed or required.

The air circuit breaker(s) (ACB) can be operated locally or remotely.

<b>Included as described in the Switchgear incomer</b>	<p>Generator(s) incomer local breaker display (LBD)</p> 
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	<p>Measurement/alarms:</p> <ul style="list-style-type: none"> <li>• Gen &amp; Bus Voltage</li> <li>• Gen &amp; Bus Freq.</li> <li>• Current</li> <li>• Power</li> <li>• Power factor</li> <li>• Status Indication</li> <li>• Instrument Indication</li> <li>• Alarm Acknowledge</li> <li>• Trip Reset</li> </ul>	<p>Generator(s) incomer on the local breaker display (LBD)</p> 
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#### 4.1.3 General incomer W. digital Layer – HW instruments and functions

Item	Qty	Description	Scale	Accuracy	HW components
1	3	Ampere meter	130 % of rated current	2.5 % or higher	
2	1	Voltmeter w. phase selector switch (for the incomer and busbar)	120 % of nominal voltage	2.5 % or higher	
3	1	Frequency meter for the incomer and busbar)	8 % above and below nominal frequency	2.5 % or higher	
4	1	Active power meter (kW)	130 % of rated current		
5	1	Local/remote selector switch			

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#### 4.1.4 General incomer W. digital Layer – Protection functions

The local synchronizing and protection (LSP) unit is a highly configurable controller designed for marine use. The controller contains the functions required to protect and control a generator and its breaker or bus tie breakers. Each controller includes processors and high-speed internal communication with fast protection.



ANSI code	IEC	Description	Latch	IAS alarms	Circuit breaker trip	AVR de-excitation trip	Protection
27	U<, U<<	Under-voltage	X	X			Voltage
32	P>, P>>	Overload	X <sup>1</sup>				Power
32R	P<, P<<	Reverse power	X	X			Power
400	Q>, Q>>	Reactive power export	X				AVR
40U	Q<, Q<<	Reactive power import	X				AVR
50TD	3I>, 3I>>	Overcurrent	X	X			Current
50/50TD	3I>>>	Fast overcurrent	X		X	X	Current
50BF		Breaker failure	X	X	X		Breaker
51	It>	Inverse time overcurrent	X	X	X		Current
59	U>, U>>	Overvoltage	X	X <sup>2</sup>			Voltage
67	I0φ	Directional overcurrent	X	X	X <sup>3</sup>		Current
81U	f<, f<<	Under-frequency	X				Frequency
81O	f>, f>>	Over-frequency	X				Frequency
87G	Id>>	Differential protection	X	x	X	X	≥1500 kVA (DNV)

<sup>1</sup> Preferential trip output on the LSP, overload protection 1 and 2 as the source. Need to implement a DO in the LSP.

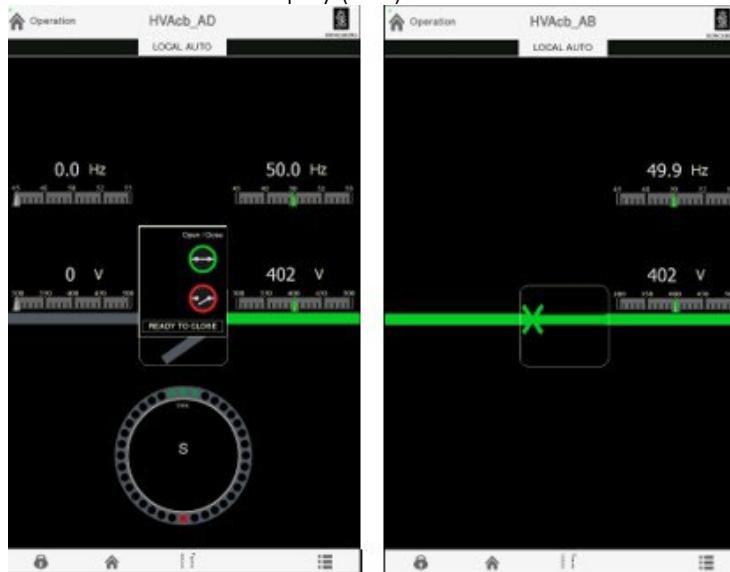
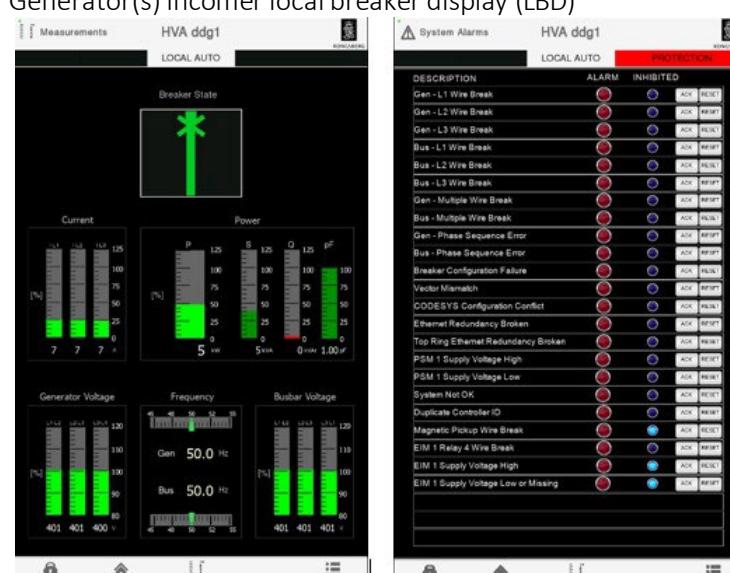
<sup>2</sup> The generator must have a time delay due to coordination/selectivity and the bus tie to have the first trip.

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#### 4.1.5 Bus tie W. digital Layer – ACB and touchscreen functions

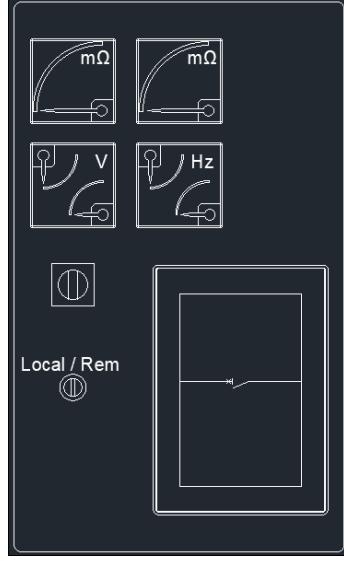
Included is Kongsberg K-Power Digital Layer with fast measurement, protection, and functions. The plug-and-play interface to K-Chief PMS/EMS is done by Modbus TCP. Therefore, no additional transducers are installed or needed.

Air circuit breaker(s) (ACB) can be operated locally or remotely.

<p>Included as described in the <i>Switchgear incomer and feeders chapter</i>.</p>	<p><b>Bus tie local breaker display (LBD)</b></p> 
<p><b>Measurement/alarms:</b></p> <ul style="list-style-type: none"> <li>• Bus 1 &amp; Bus 2 Voltage</li> <li>• Bus 1 &amp; Bus 2 Freq.</li> <li>• Power</li> <li>• Power factor</li> <li>• Status Indication</li> <li>• Instrument Indication</li> <li>• Alarm Acknowledge</li> <li>• Trip Reset</li> </ul>	<p><b>Generator(s) incomer local breaker display (LBD)</b></p> 

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#### 4.1.6 Bus tie W. digital Layer – HW instruments and functions

Item	Qty	Description	Scale	Accuracy	HW components
1	0				
2	1	Voltmeter w. phase selector switch (busbar 1 and busbar 2)	120 % of nominal voltage	2.5 % or higher	
3	1	Frequency meter for incomer and busbar	8 % above and below nominal frequency	2.5 % or higher	
4	1	Local/remote selector switch			
5	2	Insulation guard (one on each busbar)			

#### 4.1.7 Bus tie W. digital Layer – protection functions

The local synchronizing and protection (LSP) unit is a highly configurable controller designed for marine use. The controller contains the functions required to protect and control a generator and its breaker or bus-tie breakers. Each controller includes processors and high-speed internal communication with fast protection. Alternatively, the protection may be a Micrologic that is integrated into the ACB.



ANSI code	IEC	Description	Latch	IAS alarms	Circuit breaker trip	AVR de-excitation trip	Protection
27	U<, U<<	Under-voltage		X			Voltage
32	P>, P>>	Overload					Power
32R	P<, P<<	Reverse power					Power
400	Q>, Q>>	Reactive power export					AVR
40U	Q<, Q<<	Reactive power import					AVR
50TD	3I>, 3I>>	Overcurrent		X	X		Current
50/50TD	3I>>>	Fast overcurrent	X		X		Current

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50BF		Breaker failure	X	X	X		Breaker
51	It>	Inverse time overcurrent	X	X	X		Current
59	U>, U>>	Overvoltage		X	X <sup>2</sup>		Voltage
67	IOφ	Directional overcurrent					Current
81U	f<, f<<	Under-frequency		X			Frequency
81O	f>, f>>	Over-frequency		X			Frequency
87G	Id>>	Differential protection					Current

<sup>1</sup> Preferential trip output on the LSP, overload protection 1 and 2 as the source. Must implement a DO in the LSP.

<sup>2</sup> The generator must have a time delay due to coordination/selectivity and the bus tie to have the first trip.

## 4.2 450V Main Switchboards

### 4.2.1 General Specification

Quantity ..... 1

### 4.2.2 Mechanical Specification

#### Main dimensions

Estimated Size (W x D x H) ..... 6250 x 600 x 2200 mm

Estimated Weight ..... 4924 kg

#### Cooling system

Cooling Method ..... Air

Estimated Heat Load to Air ..... 6017 W

#### Terminals and protection

Ingress Protection ..... P23

Access ..... Front & rear

Cable Entry ..... Bottom

Painting ..... RAL9005 (Jet Black) / RAL9006 (White Aluminum)

#### Environmental conditions

Air temperature range (room) ..... 0 – 45°C

..... condensation, splash water and ice formation not permitted

#### Construction standards

LV Air circuit breakers (ACB). Form according to ..... EC 61439

Withdrawable ..... Form 3a

LV Molded-case circuit breakers (MCCB). Form according to ..... EC 61439

Fixed/ Plug-In ..... Form 1

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<h4>4.2.3 Electrical Specification</h4>					
Bus-bar nominal voltage.....V Bus-bar nominal frequency ..... 60 Hz Bus-bar nominal rating..... 2865 A Short circuit level (Icw)..... 50 kA, 1 s. Distribution system..... IT					
<b>+01 Feeders (MCCB)</b> TYPE ..... Plug-In Feeder NS 800 A ..... 0 Feeder NSX 630 A ..... 0 Feeder NSX 400 A ..... 4 Feeder NSX 250 A ..... 4 Feeder NSX 160 A ..... 0 Feeder NSX 100 A ..... 2 Feeder NSXm 160 A ..... 0 Feeder NSXm 63 A ..... 0					
<b>+02 Feeder (ACB)</b> Name..... CARGO1 Generator Rated Active Power ..... 600 kVA ACB Rated Current..... 800 A MicroLogic..... 5					
<b>+03 HVSC Incomer (ACB)</b> Name..... HVSC Generator Apparent Power ..... 1850 kVA ACB Rated Current..... 2900 A LBD..... Yes LSP..... Yes					
<b>+04 Shaft Generator Incomer (ACB)</b> Name..... SG Generator Apparent Power ..... 688 kVA ACB Rated Current..... 1000 A Form Factor 4b Selected ..... No LBD..... Yes LSP..... Yes					
<b>+05 Generator Incomer (ACB)</b> Name..... G3 Generator Apparent Power ..... 938 kVA ACB Rated Current..... 1250 A LBD..... Yes LSP..... Yes					
<b>+06 Bus-Tie (ACB)</b> Name..... Bus-Tie Rated Apparent Power..... 1750 kVA ACB Rated Current..... 2900 A MicroLogic Included..... 5 LBD..... Yes LSP..... Yes					

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<b>+07 Generator Incomer (ACB)</b>			
Name.....	G2		
Generator Apparent Power .....	938 kVA		
ACB Rated Current.....	1250 A		
LBD.....	Yes		
LSP.....	Yes		
<b>+08 Generator Incomer (ACB)</b>			
Name.....	G1		
Generator Apparent Power .....	938 kVA		
ACB Rated Current.....	1250 A		
LBD.....	Yes		
LSP.....	Yes		
<b>+09 Shore Power Incomer (ACB)</b>			
Name.....	LVSC		
Generator Apparent Power .....	380 kVA		
ACB Rated Current.....	630 A		
Form Factor 4b Selected .....	No		
LBD.....	Yes		
LSP.....	Yes		
<b>+10 Feeder (ACB)</b>			
Name.....	CARGO2		
Generator Rated Active Power .....	600 kVA		
ACB Rated Current.....	800 A		
MicroLogic.....	5		
<b>+11 Feeder (ACB)</b>			
Name.....	EMG		
Generator Rated Active Power .....	250 kVA		
ACB Rated Current.....	630 A		
MicroLogic.....	5		
<b>+12 Feeders (MCCB)</b>			
TYPE .....	Plug-In		
Feeder NS 800 A .....	0		
Feeder NSX 630 A .....	0		
Feeder NSX 400 A .....	4		
Feeder NSX 250 A .....	4		
Feeder NSX 160 A .....	0		
Feeder NSX 100 A .....	2		
Feeder NSXm 160 A .....	0		
Feeder NSXm 63 A .....	0		

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	<b>I-PT-4880.00-7109-200-CZ1-001</b>	REV.: <b>0</b>		
	TP 25 – PRODUCT CARRIERS 15600 DWT	SHEET: <b>15 of 25</b>			
	TITLE: <b>TECHNICAL PROPOSAL FOR SWITCHBOARDS</b>	LOG/PL/EGE			
			<b>INTERNAL</b>		
<b>4.3 450V Emergency Switchboards</b>					
<b>4.3.1 General Specification</b>					
Quantity .....			1		
<b>4.3.2 Mechanical Specification</b>					
Main dimensions					
Estimated Size (W x D x H).....			2050 x 600 x 2200 mm		
Estimated Weight .....			1830 kg		
Cooling system					
Cooling Method.....			Air		
Estimated Heat Load to Air.....			2596 W		
Terminals and protection					
Ingress Protection .....			P23		
Access .....			Front & rear		
Cable Entry.....			Bottom		
Painting .....			RAL9005 (Jet Black) / RAL9006 (White Aluminum)		
Environmental conditions					
Air temperature range (room).....			0 – 45°C		
..... condensation, splash water and ice formation not permitted					
Construction standards					
LV Air circuit breakers (ACB). Form according to .....			EC 61439		
Withdrawable.....			Form 3a		
LV Molded-case circuit breakers (MCCB). Form according to.....			EC 61439		
Fixed/ Plug-In .....			Form 1		
<b>4.3.3 Electrical Specification</b>					
Bus-bar nominal voltage.....			V		
Bus-bar nominal frequency .....			60 Hz		
Bus-bar nominal rating.....			950 A		
Short circuit level (lcw).....			42 kA, 1 s.		
Distribution system.....			IT		
+01Generator Incomer (ACB)					
Name.....			EG		
Generator Apparent Power .....			kVA		
ACB Rated Current.....			630 A		
Form Factor 4b Selected .....			No		
LBD.....			No		
LSP.....			No		
+02 Incomer (ACB)					
Name.....			MSB		
Generator Apparent Power .....			250 kVA		
ACB Rated Current.....			630 A		
Form Factor 4b Selected .....			No		
LSP.....			No		

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	<b>I-PT-4880.00-7109-200-CZ1-001</b>	REV.: <b>0</b>
	TP 25 – PRODUCT CARRIERS 15600 DWT	SHEET:	16 of 25
	TITLE:	LOG/PL/EGE	
	<b>TECHNICAL PROPOSAL FOR SWITCHBOARDS</b>	INTERNAL	

+03 Feeders (MCCB)

TYPE .....	PlugIn
Feeder NS 800 A .....	0
Feeder NSX 630 A .....	4
Feeder NSX 400 A .....	0
Feeder NSX 250 A .....	12
Feeder NSX 160 A .....	0
Feeder NSX 100 A .....	4

#### 4.4 220V Main Switchboards

##### 4.4.1 General Specification

Quantity ..... 1

##### 4.4.2 Mechanical Specification

Main dimensions

Estimated Size (W x D x H)..... 2850 x 600 x 2200 mm  
Estimated Weight ..... 1575 kg

Cooling system

Cooling Method..... Air  
Estimated Heat Load to Air..... 2356 W

Terminals and protection

Ingress Protection..... P23  
Access ..... Front & rear  
Cable Entry ..... Bottom  
Painting ..... RAL9005 (Jet Black) / RAL9006 (White Aluminum)

Environmental conditions

Air temperature range (room)..... 0 – 45°C  
..... condensation, splash water and ice formation not permitted

Construction standards

LV Air circuit breakers (ACB). Form according to ..... EC 61439  
Withdrawable..... Form 3a  
LV Molded-case circuit breakers (MCCB). Form according to..... EC 61439  
Fixed/ Plug-In ..... Form 1

##### 4.4.3 Electrical Specification

Bus-bar nominal voltage..... V  
Bus-bar nominal frequency ..... 60 Hz  
Bus-bar nominal rating..... 950 A  
Short circuit level (lcw)..... 42 kA, 1 s.  
Distribution system..... IT

+01 Feeders (MCCB)

TYPE .....	Fixed
Feeder NS 800 A .....	0
Feeder NSX 630 A .....	2
Feeder NSX 400 A .....	0
Feeder NSX 250 A .....	6

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	<b>I-PT-4880.00-7109-200-CZ1-001</b>	REV.: <b>0</b>
	TP 25 – PRODUCT CARRIERS 15600 DWT	SHEET: <b>17 of 25</b>	
	TITLE: <b>TECHNICAL PROPOSAL FOR SWITCHBOARDS</b>	LOG/PL/EGE	
		INTERNAL	
<hr/>			
Feeder NSX 160 A .....	0		
Feeder NSX 100 A .....	2		
Feeder NSXm 160 A .....	0		
Feeder NSXm 63 A .....	0		
+02 Transformer Incomer (ACB)			
Name.....	T1		
Generator Apparent Power .....	250 kVA		
ACB Rated Current.....	630 A		
+03 Transformer Incomer (ACB)			
Name.....	T2		
Generator Apparent Power .....	250 kVA		
ACB Rated Current.....	630 A		
+04 Bus-Tie (ACB)			
Name.....	BT		
Rated Apparent Power.....	250 kVA		
ACB Rated Current.....	800 A		
+05 Feeders (MCCB)			
TYPE .....	Fixed		
Feeder NS 800 A .....	0		
Feeder NSX 630 A .....	2		
Feeder NSX 400 A .....	0		
Feeder NSX 250 A .....	6		
Feeder NSX 160 A .....	0		
Feeder NSX 100 A .....	2		
Feeder NSXm 160 A .....	0		
Feeder NSXm 63 A .....	0		
<b>4.5 220V Emergency Distribution Board</b>			
<b>4.5.1 General Specification</b>			
Quantity .....	1		
<b>4.5.2 Mechanical Specification</b>			
Main dimensions			
Estimated Size (W x D x H).....	1450 x 600 x 2200 mm		
Estimated Weight .....	768 kg		
Cooling system			
Cooling Method.....	Air		
Estimated Heat Load to Air.....	1623 W		
Terminals and protection			
Ingress Protection.....	P23		
Access .....	Front & rear		
Cable Entry.....	Bottom		
Painting .....	RAL9005 (Jet Black) / RAL9006 (White Aluminum)		

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	<b>I-PT-4880.00-7109-200-CZ1-001</b>	REV.: <b>0</b>
	TP 25 – PRODUCT CARRIERS 15600 DWT	SHEET:	18 of 25
	TITLE: <b>TECHNICAL PROPOSAL FOR SWITCHBOARDS</b>	LOG/PL/EGE	
		INTERNAL	

Environmental conditions

Air temperature range (room)..... 0 – 45°C  
..... condensation, splash water and ice formation not permitted

Construction standards

LV Air circuit breakers (ACB). Form according to .....	EC 61439
Withdrawable.....	Form 3a
LV Molded-case circuit breakers (MCCB). Form according to.....	EC 61439
Fixed/ Plug-In .....	Form 1

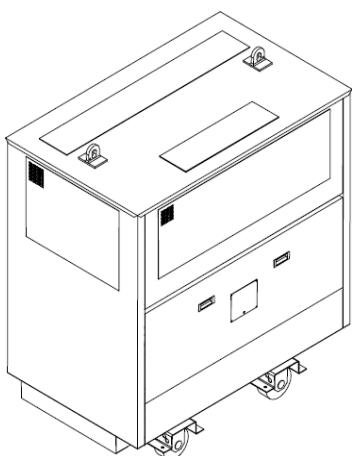
#### 4.5.3 Electrical Specification

Bus-bar nominal voltage.....	V
Bus-bar nominal frequency .....	60 Hz
Bus-bar nominal rating.....	950 A
Short circuit level (lcw).....	42 kA, 1 s.
Distribution system.....	IT

+01Feeders (MCCB)

TYPE .....	Fixed
Feeder NS 800 A.....	0
Feeder NSX 630 A .....	5
Feeder NSX 400 A .....	0
Feeder NSX 250 A .....	11
Feeder NSX 160 A .....	0
Feeder NSX 100 A .....	4
Feeder NSXm 160 A.....	0
Feeder NSXm 63 A .....	0

#### 4.6 Main Transformers



##### 4.6.1 General Specification

Qty .....	2
Application / Environment.....	Distribution
Transformer Type .....	Dry transformer

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	<b>I-PT-4880.00-7109-200-CZ1-001</b>	REV.: <b>0</b>
	TP 25 – PRODUCT CARRIERS 15600 DWT	SHEET: 19 of 25	
	TITLE: <b>TECHNICAL PROPOSAL FOR SWITCHBOARDS</b>	LOG/PL/EGE	
		INTERNAL	

#### 4.6.2 Electrical Specification

Rated Apparent power .....	250 kVA
Duty.....	Continuous
Load type.....	Distribution THD 8 %
Number of phases.....	3
Connection .....	Dy11
Primary voltage.....	V
Secondary voltage.....	V
Rated frequency .....	60 Hz
Insulation class.....	H
Temperature rise class .....	F
Cu screen.....	Not Included
Pre-magnetization.....	Included

#### 4.6.3 Mechanical Specification

Ingress Protection .....	P23
Cable entry primary side .....	Bottom
Cable entry secondary side.....	Bottom
Power cable terminals (No. of cables).....	Manufacturer's standard
Windings .....	Aluminium
Enclosure.....	Steel
Terminals.....	Cu
Environment / Climatic / Fire class.....	E1 / C1 / F0
Colour .....	RAL 7035
MCT frame .....	Included
Cooling system	
Cooling method .....	AN
Estimated heat load to air .....	5.0kW

#### Main dimensions

Estimated Size (W x D x H).....	1200 x 1000 x 1300 mm
Estimated Weight .....	900 kg

#### Terminals and protection

Winding temperature monitoring .....	PT-100
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#### Environmental conditions

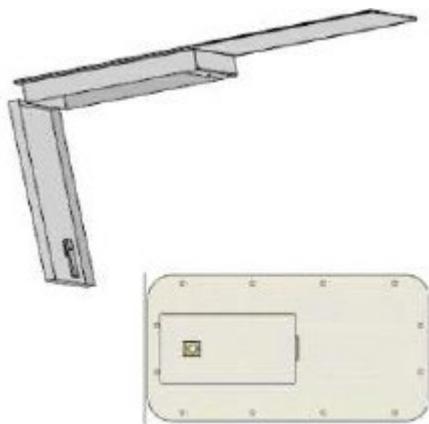
Air temperature range (room).....	0 – 45 °C
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 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	<b>I-PT-4880.00-7109-200-CZ1-001</b>	REV.: <b>0</b>
	TP 25 – PRODUCT CARRIERS 15600 DWT	SHEET:	20 of 25
	TITLE:	LOG/PL/EGE	
	<b>TECHNICAL PROPOSAL FOR SWITCHBOARDS</b>	INTERNAL	

#### 4.7 Low Voltage Shore Connection Cabinet



The CSCC panel is a conventional shore connection panel with a circuit breaker and connection point for shore power cables. The cable entry is through a hatch and the cables are connected by lugs and bolts.



##### 4.7.1 General Specification

Qty ..... 1  
 Panel type..... CSCC4-8V

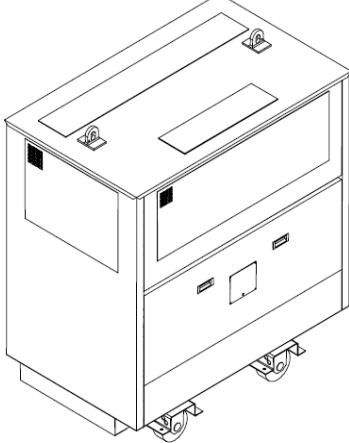
##### 4.7.2 Mechanical Specification

Estimated Size TBC (W x D x H)..... 760 x 300 x 760 mm  
 Ingress Protection ..... P 44  
 Cable entry ..... Hatch

##### 4.7.3 Electrical Specification

Rated Voltage ..... V  
 Rated Frequency..... 60 Hz  
 Rated Current..... 500A  
 Number of phases..... 3 ph. + 1 P.E

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	<b>I-PT-4880.00-7109-200-CZ1-001</b>	REV.: <b>0</b>		
	TP 25 – PRODUCT CARRIERS 15600 DWT	SHEET: <b>21 of 25</b>			
	TITLE: <b>TECHNICAL PROPOSAL FOR SWITCHBOARDS</b>	LOG/PL/EGE			
			<b>INTERNAL</b>		
<b>4.8 Hight Voltage Shore Connection Switchboard (OPTION)</b>					
<b>4.8.1 General Specification</b>					
Quantity .....	1 pcs.				
Type .....	Kongsberg High Voltage Switchboard				
<b>4.8.2 Mechanical Specification</b>					
Main dimensions					
Estimated Size (W x D x H).....	1280 x 1320 x 2750 mm				
Estimated Weight.....	1660 kg				
Cooling system					
Cooling Method.....	Air Natural				
Estimated Heat Load to Air.....	0.5 kW				
Air flow.....	TBC m <sup>3</sup> /h				
Terminals and protection					
Ingress Protection .....	IP 42 (Open bottom)				
Access Requirement.....	Front & Back				
Cable Entry .....	Bottom				
Painting .....	RAL9005 (Jet Black) / RAL9006 (White Aluminum)				
Environmental conditions					
Air temperature range (room).....	0 – 45°C				
Degree of pollution.....	2 (IEC/EN 61800-5-1)				
Air humidity.....	5-95 %rh				
.....	Condensation, splash water and ice formation not permitted				
Air pressure equivalence .....	≤ 2000 masl				
Displacement limit (vibration) .....	1.0 mm at 2 - 13.2 Hz				
Acceleration limit (vibration) .....	0.7 g at >13.2 .... 100 Hz				
Radio interference .....	special power distribution zone (IEC 60533)				
Construction standards					
Design .....	EC 62271-200				
Vacuum circuit breakers (VCB) .....	EC62271-100				
Withdrawable .....	Form Factor 3b				
<b>4.8.3 Electrical Specification</b>					
Bus nominal voltage.....	..... kV				
Bus rated voltage.....	..... kV				
Bus nominal frequency.....	..... 60 Hz				
Bus nominal current.....	..... 1250 A				
Short circuit level (lcw).....	..... 25 kA, 1 s.				
Distribution system.....	..... IT				
+01 Auxiliary Panel (Riser panel)					
Name.....	BUSMEASURE				
VCB Rated Current.....	..... N.A				

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	<b>I-PT-4880.00-7109-200-CZ1-001</b>	REV.: <b>0</b>
	TP 25 – PRODUCT CARRIERS 15600 DWT	SHEET: 22 of 25	
	TITLE: <b>TECHNICAL PROPOSAL FOR SWITCHBOARDS</b>	LOG/PL/EGE	
		INTERNAL	
Protection Device .....	N.A		
Grounding Switch .....	Yes (Bus Grounding)		
+02 Switchboard Feeder			
Name.....	MS1		
VCB Rated Current .....	630A		
Protection Device .....	P3F30		
Grounding Switch .....	Yes (Cable Side)		
<b>4.9 Hight Voltage Shore Connection Transformer (OPTION)</b>			
			
<b>4.9.1 General Specification</b>			
Qty .....	1		
Application / Environment.....	Shore Connection		
Transformer Type .....	Dry transformer		
<b>4.9.2 Electrical Specification</b>			
Rated Apparent power.....	1850 kVA		
Duty.....	Continuous		
Load type.....	Distribution THD 8 %		
Number of phases.....	3		
Connection .....	Dy11		
Primary voltage .....	.6600 V		
Secondary voltage.....	V		
Rated frequency .....	60 Hz		
Insulation class.....	H		
Temperature rise class .....	F		
Cu screen.....	Not Included		
Pre-magnetization.....	Included		

 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	<b>I-PT-4880.00-7109-200-CZ1-001</b>	REV.: <b>0</b>
	TP 25 – PRODUCT CARRIERS 15600 DWT	SHEET: 23 of 25	
	TITLE: <b>TECHNICAL PROPOSAL FOR SWITCHBOARDS</b>	LOG/PL/EGE	
		INTERNAL	

#### 4.9.3 Mechanical Specification

Ingress Protection .....	P44
Cable entry primary side .....	Bottom
Cable entry secondary side.....	Bottom
Power cable terminals (No. of cables).....	Manufacturer's standard
Windings .....	Aluminium
Enclosure.....	Steel
Terminals.....	Cu
Environment / Climatic / Fire class.....	E1 / C1 / F0
Colour .....	RAL 7035
MCT frame.....	Included
Cooling system	
Cooling method .....	AFWF
Estimated heat load to air .....	TBC
Coolant inlet temperature range (ship side).....	38 °C
Secondary Cooling .....	Freshwater w/glycol
Cooling fan .....	450 V, 60 Hz

#### Main dimensions

Estimated Size (W x D x H).....	2700 x 1800 x 2000 mm
Estimated Weight .....	5000 kg

#### Terminals and protection

Winding temperature monitoring .....	PT-100
Leakage detector .....	Yes

#### Environmental conditions

Air temperature range (room).....	0 – 45 °C
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### 4.10 Electrical Studies

A model of the electrical system is made based on information about loads and power supply. The vessel load list is needed as input to the model.

The results of the simulations will be delivered as documents according to the Supplier master document lists (SMDL). Information from client related to systems and items outside of Kongsberg's scope of supply must be in hand within due time to perform the analysis and deliver the documents according to the documentation plan.

#### 4.10.1 Deliverables

The Following documents will be supplied:

- Short Circuit Calculation (for defined operational modes)
- Voltage-drop analysis
- Protection coordination (for KM delivered switchboards)
- Load flow study

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	TP 25 – PRODUCT CARRIERS 15600 DWT	SHEET: 24 of 25	
	TITLE: <b>TECHNICAL PROPOSAL FOR SWITCHBOARDS</b>	LOG/PL/EGE	
		INTERNAL	

An arc flash test of Kongsberg Low Voltage switchboard has been performed, test report will be submitted.

## 5. Spare Parts

Operational spare parts for two years are not required but can be added upon request.

## 6. Commissioning

Ref. to Kongsberg Maritime General Terms and Conditions for Commissioning Services

Commissioning:

40 days (at 10 hours per day)

Waiting time is not included and will be invoiced. Living and lodging expenses for the period are included

Additional assistance:

Additional assistance will be charged in accordance with Kongsberg standard rates

## 7. Training

Not included

## 8. CLASS

The equipment and system will be delivered in accordance with BV (Bureau Veritas)

The following notations will be applicable:

I, OIL TANKER, ESP, METHANOLFUEL-PREPARED (S, T, H, P, ME-DF, AE, B), CPS(WBT), COMF-VIB 3, COMF-NOISE 3, AUT-UMS, AVM, SYS-NEQ-1, CARGOCONTROL, LI-S3, VCS-TRANSFER, IG, SPM, CYBER SECURE, SMART (EnE2), ETA, BWT, CLEANSHIP, SOX-x%, GREENPASSPORT, INWATERSURVEY, MON-SHAFT, ALM

## 9. Factory Acceptance Tests

For equipment with project specific certification requirement a standard workshop test in the presence of class surveyor and customer (if required) will be performed.

The following equipment is subject to project specific certification:

- 450V Main Switchboard
- 450/220V Emergency Switchboard
- 220V Main Switchboard
- Main Transformers

For equipment without project specific certification requirement a standard workshop test will be performed or following suppliers QA system

## 10. Documentation

A project specific SMDL (Supplier Master Document List) will be provided soon after project is established. It will contain all documents related to the products and systems specified in this technical quotation. The SMDL also contains information about when each document will be ready, and who shall receive it.

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	TP 25 – PRODUCT CARRIERS 15600 DWT	SHEET:	25 of 25
	TITLE:	LOG/PL/EGE	
	<b>TECHNICAL PROPOSAL FOR SWITCHBOARDS</b>		INTERNAL

## 11. List of Attachments

Main Single Line Diagram  
 450V Main Switchboard – General Arrangement 220V Main  
 Switchboard – General Arrangement  
 450V/220V Emergency Switchboard – General Arrangement