

**ตารางแสดงวงเงินงบประมาณที่ได้รับจัดสรรและราคากลาง(ราคาอ้างอิง)
ในการจัดซื้อจัดจ้างที่มีชิ้นงานก่อสร้าง**

๑. ชื่อโครงการ.....การจัดหา Main Switch Board, Distribution Board, Group Starter, Transformer (Lock Out Equipments) โครงการเรือตรวจการณ์ไกลฝั่ง
กิจกรรม.....จัดหาการจัดหา Main Switch Board, Distribution Board, Group Starter, Transformer (Lock Out Equipments) โครงการเรือตรวจการณ์ไกลฝั่ง
/หน่วยงานเจ้าของโครงการ สำนักโครงการเรือตรวจการณ์ไกลฝั่ง ลำที่ ๒ บริษัท อุ่กรุงเทพ จำกัด
๒. วงเงินงบประมาณที่ได้รับจัดสรร ๒๐,๓๓๐,๐๐๐.๐๐ บาท (รวมภาษีมูลค่าเพิ่ม ๗%)
๓. วันที่กำหนดราคากลาง (ราคาอ้างอิง) วันที่ ๑๑ สิงหาคม ๒๕๕๙
เป็นเงิน ๑๙,๘๙๑,๓๐๐.๐๐ บาท (รวมภาษีมูลค่าเพิ่ม ๗%)
๔. แหล่งที่มาของราคากลาง (ราคาอ้างอิง)
จากการสืบราคาปัจจุบัน จากบริษัทผู้แทนจำหน่าย ดังนี้
๔.๑ บริษัท ซีเมนส์ จำกัด
๕. รายชื่อเจ้าหน้าที่ผู้กำหนดราคากลาง (ราคาอ้างอิง)
๕.๑ นางจันทร์ทิพย์ ชำศิริพงษ์ หัวหน้าแผนกบริหารงานพัสดุ
๕.๒ นายธนาพิพัฒน์ วุฒิมวงศ์ พัสดู ๑

Term of Reference (TOR)
Main Switch Board, Distribution Board, Group Starter, Transformer
(Lock Out Equipments) for the Royal Thai Navy
Offshore Patrol Vessel

1. Objective

The Bangkok Dock Company (1957) Limited (Buyer) wishes to announce this Term of Reference (TOR) for procuring Main Switch Board, Distribution Board, Group Starter, Transformer (Lock Out Equipments) for the construction of the Royal Thai Navy Offshore Patrol Vessel (OPV)

2. Requirement

2.1 Goods shall be 1 (one) set of SIEMENS Main Switch Board, Distribution Board, Group Starter and Transformer (Lock Out Equipments) including Factory Acceptance Test (FAT) Commissioning, Setting to Work, Harbour Acceptance Trial, Sea Acceptance Trial and Operation Training.

2.2 Marine Class approval by Lloyd's Register for Main Switch Boards shall be provided.

2.3 The detail and scope of supplies are in ANNEX A: Technical Requirement Specification and ANNEX B: Electrical Plant.

2.4 Goods shall be assembled in the Thailand.

2.5 Goods shall be new and never been used.

3. Condition of Bidding

3.1 The bid price shall include all costs, expenses, fees, insurance, Value Added Tax (VAT), (currently), and cost for all transportations. For imported goods, transportation shall be CIF LaemChabang Port, Chonburi, Thailand in accordance with Incoterms 2010 (by vessel with Thai flag or same privilege).

3.2 This bid price shall exclude customs duty for the list of materials imported into the Kingdom of Thailand.

3.3 The enumeration of the bid price must be provided in Total Price

3.4 The price shall be separated per items as required in 2.1 and validity shall be until 30th September 2016.

4. Qualification of Bidder

4.1 Bidder must be a professional to sell goods in this bid.

4.2 Bidder has never been on the blacklist of the Thai Government, or as a result of not receiving orders to another entity or person who is blacklisted by the Thai Government.

4.3 Bidder must act as principal for its own account and not as agent or broker. If any Bidder has a coordinator in Thailand, the name and contact details of such coordinator must be clearly specified in the proposal.

4.4 Bidder must have own bank account where receive/payment shall be made, except, if each payment is not over 30,000 Bath, the counter party may receive/paid by cash.

5. Document for Consideration

5.1 Bidder's Qualification Document

5.1.1 Copy of Company Registration/Affidavit 1 and certified true copy.

5.1.2 Letter of power of attorney, in case of the bidder is authorized the behalf to bid, sign in the bid, or in the other cases. The letter shall be affixed the duty and enclosed with the copy of the identity card or passport and/or household

registration, which declare both of the authorizer and behalf. Notarisation is required.

5.2 Technical Specification Document

5.2.1 The details of specification of goods in this bid must meet the buyer's requirements. The bidder must clearly identify the manufacturer profile and the country of origin.

5.2.2 Copy of List of document showing that the bidder sold similar system to install in the Royal Thai Navy Offshore Patrol Vessel.

5.2.3 If the Technical Specification documents do not comply with item 5.2.1 - 5.2.2, the buyer reserves the right not to consider the bidder.

6. Delivery and Acceptance

6.1 If the goods are transported via sea freight that has Thai flag or the same privilege vessel in operation, Thai flag or the same privilege vessel shall be used. Relevant Bill of Lading shall also be provided.

6.2 In the event that the delivery will be delayed due to the non-availability of a Thai Registered Vessel, the bidder shall request an exemption from Bangkok Dock and will be responsible for any such costs incurred seeking such an exemption from the relevant authorities in Thailand. The bidder shall give a minimum of 30 days' notice of a request for an exemption.

6.3 The bidder must declare document and/or evidence of delivered goods that meet the specification and standard which specified in Contract or purchase order (PO) as stated in all respects.

6.4 If the delivered goods from bidder do not meet the requirements, buyer reserves the right to reject those goods. And in this case, the bidder must immediately take the right to change immediately.

6.5 The imported goods shall be CIF Laem Chabang Port, Chonburi, Thailand not more than 12 weeks after receiving Purchasing Order (PO) or Contract Effective Date (CED).

6.6 Goods which successfully pass FAT shall be delivered to the Bangkok Dock Warehouse, Sattahip, Chonburi, not more than 16 weeks after receiving Purchasing Order (PO) or Contract Effective Date (CED).

7. Warranty

Warranty period shall be not less than 12 months after the ship delivery to the RTN.

8. Assurance

All Main Switch Boards shall be according to class rules subjected to class approval. Bidder shall provide the class certificates in original. In some single cases only copies of class certificates could be accepted.

The bidder shall confirm the quality assurance by issuing a copy of its quality plan that complies with ISO (latest standard) at no extra cost to the buyer.

9. Penalty

If the bidder cannot deliver on time as buyer's scheduled, bidder must pay on a daily rate penalty of 0.2 percent of the goods value that are not delivered from the date of delivery until the date that the bidder has fulfilled the conditions in the contract or PO.

When the penalty reaches the maximum of 10% and if the equipment is still not delivered after this period then buyer shall be entitled to terminate the contract and seek further recompense if buyer has to source an alternative supplier for the equipment. In addition buyer would expect a refund of all payments made.

10. Performance Guarantee

At the time of execution of the contract, the bidder shall submit to buyer a Performance Guarantee in an amount of five percent (5%) of the contract value in favour of the buyer by a first class bank operating in Thailand. The Performance Guarantee shall valid until the end of the agreed warranty period.

In the event the bidder requires an advance payment, the bidder shall issue an Advance Payment Guarantee via a first class bank operating in Thailand and remain valid up to the point of delivery. No advance payment will be made until the Advance Payment Guarantee has been issued to buyer.

11. Condition of Payment

11.1 Payments shall be;

- 15% advance payment against an advance payment guarantee of 15 percent of contract value in favour of the buyer
- 80% on the delivery of goods at the Bangkok Dock warehouse, Sattahip Chonburi
- 5% after the successful Sea Acceptance Trial

11.2 Payments by this condition shall be made out of an Irrecoverable and Confirmed Letter of Credit. The bidder is responsible for any other charges related to the transfer of the bank levy, and consent to such deductions from the amount transferred in that period.

11.3 The bank must be a first class bank operating in Thailand.

12. Export Licenses/End User Certificate

In the event of the bidder's equipment requires bidder's Government to issue an Export License before the equipment can be shipped to Thailand, the bidder must advise buyer immediately and provide the required format of the End- User Certificate needed to satisfy its authorities. It should be noted that the issuing of an End-User certificate can take up to 90 days and this should be taken into consideration when requesting such a document from buyer.

13. Law of the Contract

The contract shall be subjected to the Laws of the Kingdom of Thailand with the right to go to Arbitration in the event a dispute cannot be resolved. Arbitration shall be in accordance with current ICC rules and shall take place in Bangkok, Thailand.

14. Technical Requirement

ANNEX A: Technical Requirement Specification

ANNEX A
Technical Requirement Specification
Main Switch Board, Distribution Board, Group Starter, Transformer
(Lock Out Equipments) for the Royal Thai Navy Offshore Patrol Vessel

1. Requirement

1 (one) set of SIEMENS Main Switch Board, Distribution Board, Group Starter and Transformer (Lock Out Equipments) including Factory Acceptance Test (FAT) Commissioning, Setting to Work, Harbour Acceptance Trial, Sea Acceptance Trial and Operation Training.

2. Technical Specifications

2.1 Functionalities

The equipments shall provide the similar functionalities as installed in HTMS Krabi and comply with the electrical requirements as stated in ANNEX B (where appropriate). Power Management equipment shall be integral part of the Main Switch Board and can be interfaced with the Integrated Platform Management System (IPMS).

2.2 Equipment Design

The required lock out equipments shall be designed according to the following detail drawings:

- One line diagram for Main Switch Board No.1 (MSB1)
DWG. No. B90-552-320-10-01-00 Rev.A1, Date 06/05/16, 6 Sheet
- One line diagram for Main Switch Board No.1 (MSB2)
DWG. No. B90-552-320-10-02-00 Rev.A1, Date 06/05/16, 6 Sheet
- One line diagram for Electrical Distribution Center No.1 (EDC1)
DWG. No. B90-552-320-10-03-00 Rev.A1, Date 06/05/16, 2 sheet
- One line diagram for Electrical Distribution Center No.2 (EDC2)
DWG. No. B90-552-320-10-04-00 Rev.A1, Date 06/05/16, 2 sheet
- One line diagram for 3ph 380V 50Hz Power Switch Board No.1 (380PSB1)
DWG. No. B90-552-320-10-05-00 Rev.A1, Date 06/05/16, 2 sheet
- One line diagram for 3ph 380V 50Hz Power Switch Board No.2 (380PSB2)
DWG. No. B90-552-320-10-06-00 Rev.A1, Date 06/05/16, 2 sheet
- One line diagram for 3ph 380V 50Hz Power Switch Board No.3 (380PSB3)
DWG. No. B90-552-320-10-07-00 Rev.A1, Date 06/05/16, 2 sheet
- One line diagram for 3ph 380V 50Hz Power Switch Board No.1 (380PSB4)
DWG. No. B90-552-320-10-08-00 Rev.A1, Date 06/05/16, 3 sheet
- One line diagram for 3ph 440/115V 60Hz Power Distribution Panel (440/115PDP)
DWG. No. B90-552-320-40-01-00 Rev.A1, Date 05/05/16, 3 sheet
- One line diagram for 3ph 380V 50Hz Propulsion Plant, Port Group Starter Panel
DWG. No. B90-552-320-10-11-00 Rev.A1, Date 04/03/16, 1 sheet
- One line diagram for 3ph 380V 50Hz Propulsion Plant, STBD. Group Starter Panel
DWG. No. B90-552-320-10-12-00 Rev.A1, Date 04/03/16, 1 sheet

3. Main Equipments

The main equipments shall be at least as followings:

Item	Description	Brand	Q'Ty	Unit
A.	SUPPLY PORTION			
1.	Main Switchboard			
1.1	AC MAIN SWITCH BOARD NO.1 / MSB1		1	Set
	Incoming :			
	3P ACB 1250AT/1250 AF, ETU25B for GEN.1,2	SIEMENS	2	Ea
	3P ACB 800AT/1250AF, ETU25B for Shore	SIEMENS	1	Ea
	3P ACB 1250AT/1250AF, ETU25B for TIE BUS	SIEMENS	1	Ea
	3P ACB 2000AT/2000AF, ETU25B for TIE BUS	SIEMENS	1	Ea
	PPM-3	DEIF	5	Ea
	Metering device	DEIF	1	Lot
	Outgoing Feed :			
	3P MCCB 160AF with Plug in	SIEMENS	25	Ea
	3P MCCB 400AF with Plug in	SIEMENS	5	Ea
	3P MCCB 630AF with Plug in	SIEMENS	3	Ea
1.2	AC MAIN SWITCH BOARD NO.2 / MSB2		1	Set
	Incoming :			
	3P ACB 1250AT/1250 AF, ETU25B for GEN.3,4	SIEMENS	2	Ea
	3P ACB 800AT/1250AF, ETU25B for Shore	SIEMENS	1	Ea
	3P ACB 1250AT/1250AF, ETU25B for TIE BUS	SIEMENS	1	Ea
	3P ACB 2000AT/2000AF, ETU25B for TIE BUS	SIEMENS	1	Ea
	PPM-3	DEIF	5	Ea
	Metering device	DEIF	1	Lot
	Outgoing Feed :			
	3P MCCB 160AF with Plug in	SIEMENS	25	Ea
	3P MCCB 400AF with Plug in	SIEMENS	5	Ea
	3P MCCB 630AF with Plug in	SIEMENS	3	Ea

Item	Description	Brand	Q'Ty	Unit
2	<i>Distribution Board</i>			
2.1	<i>Electrical distribution Center No.1 / EDC1</i>		1	Set
	<i>Incoming :</i>			
	3P MCCB 400AF	SIEMENS	2	Ea
	Rear Interlock Module	SIEMENS	1	Ea.
	Metering device	DEIF	1	Lot
	<i>Outgoing Feed :</i>			
	3P MCCB 160AF	SIEMENS	1	Ea
	3P MCCB 250AF	SIEMENS	1	Ea
	3P MCB 63AF	SIEMENS	16	Ea
	3P MCB 125AF	SIEMENS	1	Ea
	Shunt Trip for MCB	SIEMENS	3	Ea
2.2	<i>Electrical distribution Center No.2 / EDC2</i>		1	set
	<i>Incoming :</i>			
	3P MCCB 400AF	SIEMENS	2	Ea
	Rear Interlock Module	SIEMENS	1	Ea.
	Metering device	DEIF	1	Lot
	<i>Outgoing Feed :</i>			
	3P MCCB 160AF	SIEMENS	5	Ea
	3P MCCB 250AF	SIEMENS	2	Ea
	3P MCB 63AF	SIEMENS	14	Ea
	3P MCB 125AF	SIEMENS	1	Ea
	Shunt Trip for MCB	SIEMENS	2	Ea

Item	Description	Brand	Q'Ty	Unit
2.3	3Ph 380V 50Hz Power Switch Board No.1 / 380PSB1		1	Set
	Incoming			
	3P MCCB 160AF	SIEMENS	2	Ea
	Rear Interlock Module	SIEMENS	1	Ea.
	Metering device	DEIF	1	Lot
	Outgoing Feed :			
	3P MCB 63AF	SIEMENS	20	Ea
	3P MCB 125AF	SIEMENS	3	Ea
	Shunt Trip for MCB	SIEMENS	6	Ea
2.4	3Ph 380V 50Hz Power Switch Board No.2 / 380PSB2		1	Set
	Incoming :			
	3P MCCB 400AF	SIEMENS	2	Ea
	Rear Interlock Module	SIEMENS	1	Ea.
	Metering device	DEIF	1	Lot
	Outgoing Feed :			
	3P MCCB 160AF	SIEMENS	4	Ea
	3P MCCB 250AF with shunt release	SIEMENS	2	Ea
	3P MCB 63AF	SIEMENS	13	Ea
	3P MCB 125AF	SIEMENS	1	Ea
	Shunt Trip for MCB	SIEMENS	3	Ea
2.5	3Ph 380V 50Hz Power Switch Board No.3 / 380PSB3		1	Set
	Incoming :			
	3P MCCB 160AF	SIEMENS	2	Ea
	Rear Interlock Module	SIEMENS	1	Ea.
	Metering device	DEIF	1	Lot
	Outgoing Feed :			
	3P MCB 63AF	SIEMENS	23	Ea
	3P MCB 125AF	SIEMENS	3	Ea
	Shunt Trip for MCB	SIEMENS	8	Ea

Item	Description	Brand	Q'Ty	Unit
2.6	3Ph 380V 50Hz Power Switch Board No.4 / 380PSB4		1	Set
	Incoming :			
	3P MCCB 400AF	SIEMENS	2	Ea
	Rear Interlock Module	SIEMENS	1	Ea.
	Metering device		1	Lot
	Outgoing Feed :			
	3P MCCB 160AF	SIEMENS	2	Ea
	3P MCCB 250AF with shunt release 380-600V	SIEMENS	2	Ea
	3P MCB 63AF	SIEMENS	22	Ea
	Shunt Trip for MCB	SIEMENS	6	Ea
2.7	3Ph 440/115V 60Hz Power Distribution Panel / 440/115PDP		1	Set
	Incoming 440V:			
	3P MCCB 630AF With Motorize operating Mechanisms	SIEMENS	1	Ea
	3P MCCB 160AF With Motorize operating Mechanisms	SIEMENS	2	Ea
	Metering device	DEIF	1	Lot
	Outgoing Feed 440V:			
	3P MCB 160AF	SIEMENS	1	Ea
	3P MCCB 250AF	SIEMENS	3	Ea
	3P MCB 63AF	SIEMENS	5	Ea
	3P MCB 125AF	SIEMENS	1	Ea
	Incoming 115V:			
	3P MCCB 400AF	SIEMENS	1	Ea
	Metering device	DEIF	1	Lot
	Outgoing Feed 115V:			
	3P MCB 63AF	SIEMENS	8	Ea
	3P MCB 80AF	SIEMENS	3	Ea
	3P MCB 125AF	SIEMENS	1	Ea

Item	Description	Brand	Q'Ty	Unit
2.8	<i>Port Group Starter Panel / PPGP</i>		<i>1</i>	<i>Set</i>
	Soft Starter Set for Motor 30Kw	SIEMENS	2	Set
	Star-Delta Set for Motor 11kW	SIEMENS	1	Set
	Star-Delta Set for Motor 18.5kW	SIEMENS	1	Set
	Direct online Set for Motor 2.2kW	SIEMENS	1	Set
	Direct online Set for Motor 0.18kW	SIEMENS	2	Set
2.9	<i>STBD Group Starter Panel / SPGP</i>		<i>1</i>	<i>Set</i>
	Soft Starter Set for Motor 30kW	SIEMENS	2	Set
	Star-Delta Set for Motor 11kW	SIEMENS	1	Set
	Star-Delta Set for Motor 18.5kW	SIEMENS	1	Set
	Direct online Set for Motor 2.2kW	SIEMENS	1	Set
	Direct online Set for Motor 0.18kW	SIEMENS	2	Set
2.10	<i>Marine Transformer</i>			
2.10.1	Transformer w/ housing 3Ph, 3W, Dd0, 380/220V, 50Hz, 100kVA		2	Set
2.10.2	Transformer w/ housing 3Ph, 3W, Dd0,380/220V, 50Hz, 50kVA		2	Set
2.10.3	Transformer w/ housing 3Ph, 3W, Dd0,380/220V, 50Hz, 25kVA		2	Set
2.10.4	Transformer w/ housing 3Ph, 3W, Dd0,380/220V, 50Hz, 5kVA		1	Set
2.10.5	Transformer w/ housing 3Ph, 3W, Dd0,380/220V, 50Hz, 2.5kVA		2	Set
2.10.6	Transformer w/ housing 3Ph, 3W, Dd0,440/115V, 60Hz, 50kVA		1	Set
2.10.7	Transformer w/ housing 3Ph, 3W, Dyn11,115/115V, 400Hz, 16kVA		1	Set

4 Equipment Brands

Brands of the equipments shall be as followings:

ITEMS	DESCRIPTION	BRANDS
1	AIR CIRCUIT BREAKER	SIEMENS
2	MOLDRD CASE CIRCUIT BREAKER	SIEMENS
3	MINIATURE CIRCUIT BREAKER	SIEMENS
4	STARTER	SIEMENS
5	METERING	DEIF
6	CURRENT TRANSFORMER	European Country Manufacturer
7	CONTROL TRANSFORMER	SIEMENS
8	LOAD SHARING AND SYNCRONIZING	DEIF
9	ALARM INDICATION PANEL	DEIF
10	POWER TRANSFORMER	DOE

5 Technical Documentation

The following documents are required:

- Instruction Manual for Operating and Maintenance
- Drawings (Shop drawings, As-built drawings)
- ILS document
- Technical Manual
- Factory Acceptance Test Record
- All document, 1 original, 2 copies, 1 soft copy shall be provided

6 Support Services

Bidder shall provide support services for the commissioning, Setting to Work, Harbour Acceptance and Sea Acceptance Trials.

7 Factory Acceptance Test

Buyer and the Royal Thai Navy (RTN) reserve the right to attend Factory Acceptance Tests. The bidder will be responsible for all costs in their country, including provision of test fuel and labour in the event that we wish to attend Factory Acceptance Tests. Costs of personnel travel and accommodation shall be responsible of the buyer. If there is a failure of the equipment not to pass the Factory Acceptance Test, the bidder shall be responsible for all additional costs incurred by the party attending the tests.

The bidder shall give 90 days' notice of the intended date for the Factory Acceptance Test of the equipment to enable adequate planning to be made for a team to visit. The bidder shall provide all assistance required to obtain any visa that may be required to enter the bidder's country.

8 Spare Parts

Price and list of recommended base spare parts and carried on-board spare parts for 30 days operation shall be provided.

9 Training

The bidder shall provide Operator Training at the buyer training facilities in Sattahip, Chonburi.

ANNEX B ELECTRICAL PLANT

300 ELECTRIC PLANT

300.1 General Requirement

The main electrical system shall be AC 380V 50Hz 3 phase 3 wire with ungrounded system, used by high power consumers. It shall be converted to the following systems:

- AC 440V 60Hz 3 phase 3 wire for weapon systems
- AC 220V 50Hz 3 phase 3 wire for general consumer such as galley equipment, lighting system, etc.
- AC 115V 60Hz 3 phase 3 wire for command and surveillance systems
- AC 115V 400Hz 3 phase 3 wire for fire control system and helicopter support system
- 28VDC for helicopter support system
- 24VDC for Control and Navigation light systems

300.2 Main Electrical Power Supply System

The design of electrical systems has to take the following points into consideration:

- Redundant sources for all vital loads such as command and surveillance system armament , communication system , navigation system , auxiliary system and Lighting
- Dividing into parts and sub-circuits through distribution panels
- Power consumer classification shall be divided into 3 classes:
 - Load I class
Function: Keep fighting action and ship vitality (i.e. fire-fighting system, weapon system, steering gear, etc.)
Feed lines: 2 lines on both sides from fore and aft main switchboard, respectively
 - Load II class
Function: Certain influence on fighting and navigating (anchor capstan, navigation system, refrigerator system, etc.)
Feed line: 2 lines from nearby switchboards
 - Load III class
Function: Other loads (general consumers, decorating light, galley equipment, etc.)
Feed lines: 1 line from nearby distribution boards
- Overload, over voltage/under voltage, short circuit and ground fault protection
- Grounding refers to connection to the hull of the vessel, which is assumed to be at earth potential. All weapons/ electronic equipment is to be earthed. Equipment operating at 50VDC or 35VAC and above must be earthed according to with MIL-STD-1310G and MIL- STD-1857.
- The characteristic of electrical system 380VAC, 220VAC 50Hz will be similar to the characteristic of electrical system 440VAC, 115VAC, 60Hz as specified in MIL-STD-1399 Type I. Except the electrical system 440VAC, 115VAC, the system shall comply with the MIL-STD-1399.
- Characteristic of DC electrical system shall be according to NAVSEA.
- All equipment shall be labeled. All cable shall be tagged according to NAVSEA .
- Electrical load analysis shall be prepared, indicating operating loads under ship operating conditions. Electrical load analysis shall be prepared as a preliminary

step in development of a power distribution system with adequate generating capacity according to MIL-STD-2189.

- Short circuit current evaluation shall be according to IEC 61363.
- Voltage drop calculation shall be according to IEC 60364 or Royal Thai Naval Dock Yard standard 300-002-0251.

The following ambient temperatures, for rating electrical equipment and machinery, shall be applied;

- 32°C for seawater at the intake value
- 40°C for external spaces and internal compartments other than machinery spaces
- 45°C for machinery spaces

300.3 Electrical System for offshore Patrol Vessel

300.3.1 High Voltage System

High voltage system shall be AC 380V 50Hz 3 phase 3 wire with ungrounded system, used by high power equipment. It shall be converted to AC 440V 60Hz 3 phase, 3 wires system for 60 Hz consumers, static frequency converters shall be provided

300.3.2 Medium Voltage System

Medium voltage system shall be AC 220V 50Hz 3 phase 3 wire (transformed power) used by general consumers such as galley equipment, general lighting system, etc. AC 115V 400Hz 3 phase 3 wire for fire control system. AC 115V 60Hz 3 phase 3 wire (transformed power) used by command and surveillance systems.

300.3.3 Low Voltage System

Low voltage system shall be 24VDC (rectifier / battery power) used by navigation light, emergency power for at least one hour and used by low power equipment such as IPMS.

Low voltage system (DC 28V) for Helicopter start rectifier shall be provided.

300.4 Specification for Electrical Equipment

300.4.1 General Requirement

All electrical equipments listed in section 300 shall be marine type with Classification Society Approved and selected according to shock, vibration, low-noise and low stray-field requirement and be resistant to marine environment.

All electrical calculation and drawing shall be done in accordance with RTN procedure and condition and must be approved by Classification Society and RTN before installation work can commence.

All electrical equipments shall meet the following requirements:

- High efficiency with light weight, resistance to tropical condition (heat and humidity) safe operation at great trim and heeling angle.
- Control, measuring, alarm and monitoring devices are to be provided.
- Redundant/backup equipment and manual control when automatic control equipment breaks down.
- Vibration resistance shall be according to Class certification.
- Shock resistance shall be according to Class certification.
- Noise level shall be according to Class certification.
- EMI/EMC protection shall be according to MIL-STD-461E. The cable screens are

earthed by use of cable glands according to DIN 89280 and earthing cones according to VG88812 at both ends.

- Protections of equipment shall be in accordance to Classification Society.
- Circuit breaker co-ordination.
- Ability to isolate buses and circuits.
- Simplicity, minimum space and weight requirements.
- Installation Rules.

Equipment with high explosion risk area shall be explosive proof grade according to IEC 60079.

300.4.6 Painting

When painting apparatus, care is to be taken to ensure that non paint is applied to parts, which should not be painted. In particular all spindles, plugs and sockets are to be tested after painting to see that they operate freely.

When paint spraying in compartments, electrical equipment is to be securely covered to prevent ingress of sprayed paint.

Where a concentration of electrical apparatus is fitted, spray painting is prohibited.

300.4.7 Labeling

All terminals, junction and other boxes, fuse panels, circuit breakers, switchboards, control gear, motors, motor generators, switches for red, magazine, navigation lights, weapons control and communications equipment and services, cooking and heating apparatus, are to be labeled on the outside by means of engraved plates or plates having letters describing the function of the particular fitting or apparatus.

Warning labels are to be fitted on all equipment containing voltages higher than 150VAC or 250VDC. These labels are to be in red with white lettering stating the highest voltage used in the equipment. The characters are preferably to be 10 mm high, or at least as large as the largest characters appearing elsewhere in the equipment. Manufacturers' tallies will be accepted.

The capacity and service of all fuses in switch and control gear is to be marked in a convenient place adjacent to the fitted position of the fuse.

Junction and distribution boxes and fuse panels for power services are to have engraved plates, about 15 mm², which are to be fitted to the covers, if possible, or on the bulkheads immediately adjacent to the boxes, and are to indicate particulars of the boxes and details the circuits connected and the capacity of the fuses.

The junction boxes used in the weapons control and communications systems are to have a diagram showing dispositions and marking of all terminals.

Tally plates are to be fitted adjacent to every remote push button unit, indicating lamp or audible alarm to indicate the service and function.

All tally plates designed and fitted by the ship-builder external to, or on the face of apparatus, are to be engraved in the English language.

All tally plates, including wiring or connection diagram fitted by the shipbuilder internally or on the inside of equipment are to be engraved or transcribed in the English language.

All tally plates on equipment of manufacture, other than by the shipbuilder are to be engraved in the English language.

300.4.8 Provision of Caps and Removable covers

Each cap is to be connected by a length of chain to the fitting concerned to prevent loss when removed.

300.4.9 Radio Interference Suppression

Electrical equipment is to cause minimum interference to electronic equipment. In order to achieve this, it may be necessary for certain equipment to be suppressed by suppressors in corporate in the design of the equipment.

The radio interference suppression is to be within the limits as stated in MIL-STD-461F.

Power Cables are to be separated and screened where necessary from signal cables (RF denoting radio, radar, computer, Main Broadcast and internal communication cables).

Radio Interference suppression is to be accomplished by fitting bulkhead suppressers to all power cables entering the Radio Room.

The screens of all screened cables entering the Radio room are to be individually bonded down to the hull at the nearest convenient point.

All screened cables entering the vessel from the weather deck, are to have the screening bonded to the hull at the point of entry on the internal side of the boundary.

300.4.10 Mechanical Protection

The equipment enclosures shall be such that they allow the equipment to fully perform their function in the installed environment. The degree of protection is in accordance with the rules of the classification societies. Equipment with high explosion risk area shall be explosive proof grade according to IEC 60079.

302 MOTORS AND ASSOCIATED EQUIPMENT

302.2 Motor Control Panels

Sufficient wall mount type motor controllers provide control for starting, stopping, reversing and speed selection, as determined from the requirements of the driven equipment and the motor shall be provided.

Motor controllers shall be selected from standard ranges.

Direct-on-line (DOL) starters shall be used for motor less than 5 HP (4 kW). Magnetic controllers shall be used for applications that require automatic performance. Controllers shall be provided with protective features as determined by the requirements of the driven auxiliary and in accordance with the following:

- Overload protection shall be provided in controllers for motors by means of thermistor sensor and relays.
- Short-circuit protection shall be provided by the supply circuit breaker or fuse in the supplying load centre distribution switchboard.
- Emergency run features shall be provided in controllers as required by the purchase specifications for the auxiliary machinery.

Direct-On-Line (DOL) controllers shall be in accordance with IEC292-1. Controllers shall be selected so that voltage dip on the ship service power distribution system, with a single generator supplying the load, will not exceed the values.

311 GENERATOR SETS

Generators can be synchronized automatically, semi-automatically and manually, and the load shall be automatically shared. Sequencing facility shall be provided.

In case of power black-out, the pre-set emergency generator shall automatically start.

311.1.7 Protection and Start/Stop Panel (diesel watch keeping panel)

The protection and start/stop panel shall be as part of the main switchboard in the machinery control room (MCR) and aft main switchboard.

314 POWER CONVERSION EQUIPMENT

314.1 Transformers

314.1.1 Design, standard and manufacturing

The sufficient in quantity and power capacity requirement transformers shall be manufactured by "Siemens" which designed according to DNV-GL. Transformers up to 16kVA shall be in accordance with VDE 0550 part 1 (12/69) and exceeding 16kVA acc. to VDE 0532 part 6 (01/94), other transformers shall be in accordance with VDE 0550 part 4 (04/66).

Transformer 380V/220V 50Hz, 3 phase shall be marine type and have insulation class F with IP23 for internal installation. For external installation, protection shall be IP56.

314.1.2 Types and material

All transformers shall be double winding and provided with electrostatic screen between primary and secondary windings, dry insulated and air cooled.

314.1.3 Acoustic/noise

The laminations shall be tightly clamped to reduce noise emissions and shall be according to MIL-STD-740 or equivalent DNV-GL standard.

314.1.4 EMI/EMC

All bolts passing through the magnetic circuit shall be insulated. Cable screens shall be earthed by the use of cable glands with earthing cones. Metal enclosures shall be grounded to minimize electromagnetic disturbance and shall be according to MIL-STD- 461F or equivalent DNV-GL standard.

314.1.5 Degree of Protection

IP Ratings for transformers shall be IP23 or in accordance with applicable rules of the Classification Societies.

314.1.6 Redundancy

Redundancy shall be guaranteed by using a sufficient No. of transformers by having separate lighting switchboards. All vital loads AC 220V 50Hz shall have double transformer feeders.

314.1.7 Installation

The transformer shall be either integrated in the distribution boards or built into a separate enclosure, the details shall be specified during the design phase.

The transformers shall be mounted on shock-mounts according to vibration and shock resistance MIL-STD-167B & MIL-STD-901D or equivalent DNV-GL standard.

314.1.8 Power consumption

Power consumption shall be suitable to the requirement in accordance with the installation area and shall be provided as follows:

Transformers for Lighting System

- Efficiency: not less than 97%
- Primary voltage: 380V
- Secondary voltage: 220V
- Frequency: 50Hz
- Vector group: Dd0
- Insulation class: F

Transformer for Hospital Equipment

- Efficiency: not less than 95%
- Primary voltage: 380V
- Secondary voltage: 220V
- Frequency : 50Hz
- Vector group: Dd0
- Insulation class: F

Transformers for Weapon System

- Efficiency: not less than 97%
- Primary voltage: 440V
- Secondary voltage: 115V
- Frequency : 60Hz
- Vector group: Dd0
- Insulation class: F

324 MAIN SWITCHBOARDS AND DISTRIBUTION BOARDS

324.1 Main Switchboards AC 400V 50Hz

The main switchboards, IP not less than 23, shall be manufactured by Siemens and shall provide for control, operation, and protection of the ship service generators, parallel operation of the generators with the main bus and control and protection through appropriate circuit breakers of the electric power distribution system.

Pre-selection for generator automatic starting, synchronizing and load sharing shall be provided. Parallel operation of all generators shall be possible.

Two main switchboards shall be provided, one in MCR the other in aft main switchboard room and both located on the second deck above the water level. Each main switchboard shall be mounted on shock-mount and shall include the following sections:

- 2 AC generator sections
- 1 Shore supply section
- Synchronization section
- 1 Bus-tie sections to connect between the main switchboards, and 2 Distribution sections

Note: The No. of consumer panels shall be determined by the number of power switchboards and consumers directly connected to the main switchboards. The selection of type of circuit breakers used shall be based on the results of the short

circuit analysis. Circuit breaker of generators shall be air circuit breaker (ACB) type.

324.1.1 Generator Section

Each generator control section shall have the following items mounted on or within the unit:

- One generator air circuit breaker, withdraw able, three-pole, electrically operated (motor operated stored energy closing mechanism). This circuit breaker shall have sufficient secondary contacts to suit the control system to be supplied. The circuit breaker shall provide with instantaneous and time delayed over-current trip and an approved time delayed under-voltage trip. The breaker is provided with manual closing and opening facilities and draw-out cradle complete with power and control circuit plug contacts.
- Current transformers suitable for metering, relaying and control, in numbers as required
- Fuse panel for fusing the primary circuits and all control circuits extending outside the section
- Power management devices as part of the integrated control and monitoring system (IPMS)
- Speed control equipment furnished with the diesel
- Synchronizing devices for manual and automatic synchronization of the generator with the main bus including load sharing
- Generator protection and reverse power sensing device to prevent the generator from motoring on the bus after loss of driving power from prime mover, and
- Transducers 0.4 to 20 mA., clean contacts, relays and other hardware in type and number as required for the integrated control and monitoring system.

The following devices shall be mounted on the front panels of the generator control sections:

- AC ammeter with transfer switch reading the current in each phase
- AC voltmeter with transfer switch for reading the voltage in each phase of the main power bus
- Poly-phase Wattmeter for reading the power output of the generator
- Double frequency meter for reading the frequency of the generator and the frequency of the main bus
- Insulation resistance indicator
- Set of synchronizing lights with transfer switch for synchronizing the generator with the main bus
- Control switch and indicator light (gen. c/b closed) for electrical control of the generator circuit breaker
- Control switches, potentiometers, and similar devices, as required in conjunction with the governor speed regulation of the generator prime mover
- Selector switch to transfer the local control to automatic remote control or local automatic control
- Indicator light for the generator space heaters
- Emergency stop button to shut down the generator, and
- Control switches, pushbuttons, indicator lamps, in number as required to facilitate generator set control and monitoring, automatic paralleling etc.

324.1.2 Bus Tie Section

The bus tie units each shall have the following items included within the unit:

- One bus tie air circuit breaker, 3-pole, electrically operated. This circuit breaker shall be identical to that used for the generator units.
- Control transformer
- Current transformers for metering the current interchange through the bus tie circuit
- Differential protection devices
- Fuse panel for fusing the primary circuits of the potential transformers and any control and metering circuits extending outside the unit
- Control relays in number and type as required
- Power management devices
- Transducers 0.4 to 20mA., clean contacts, relays and other hardware in type and number as required for the integrated control and monitoring system.

The following devices shall be mounted on the front panel of the bus tie unit:

- AC voltmeter with transfer switch reading the voltage in each phase
- AC ammeter with transfer switch reading the current in each phase
- Paralleling device with attached accessories for the bus-ties. Manual paralleling is accomplished through synchronizing control equipment which allows closing of the circuit breaker only when conditions are correct
- Indicator light to show the closed position of the bus-tie circuit breaker
- Control switch for control of the bus-tie circuit breaker

324.1.3 Shore Connection Section

The following items shall be installed on or within each AC shore power unit:

- One withdraw able electrically operated air circuit breaker, connected to shore power receptacles
- Current transformer for metering the total shore power
- Indicator light to indicate shore power feeder energized
- Fuse panel for fusing the primary circuits extending outside the section
- Indicator light to show the closed position of the shore power circuit breakers
- Phase sequence indicator and selector switch to indicate phase sequence of each shore feeder
- AC ammeter with transfer switch for reading the shore power current in each phase
- Synchronizing/paralleling facilities are provided to enable (for a short time only) paralleling of the main switchboards with the shore supply (manually, by operator action at the main switchboard).
- Power management devices
- Transducers 4 to 20mA., clean contacts, relays and other hardware in type and number as required for the integrated control and monitoring system

324.1.4 Distribution Sections

Distribution units shall be incorporated in the main switchboard in frame size as required to distribute ship service electric power from the main bus to all 380V, 50Hz distribution boards and direct connected loads.

324.1.5 Switchboard Design

Switchboards shall be of the low voltage compact type and especially suitable for use on ships to qualify for the use under rugged conditions.

Following a modular design, the switchgear shall comprise individual panels that can

be equipped with components in line with individual technical space requirements.

324.1.6 Frame

Switchboards shall be of the 'dead front' type. To simplify transport, several panels shall be bolted together on a common base-frame.

Each Panel shall comprise a galvanized steel frame and powder coated structure. All metal inserts and covers shall be galvanized ensuring appropriate earthing and protection against corrosion. Doors and side covers are made of powder coated sheet.

324.1.7 Bus-bars

The switchboards shall include main bus-bars with, typically, up to three parallel bus-bars, according to the electric power analysis and in accordance with the rules of the classification societies. The bus-bars shall be located at the rear of the switchboard. Transport units shall be linked by specially designed longitudinal clamps.

324.1.8 Separation

Generator panels shall be fitted with side partitions in accordance with IEC 92-302.

324.1.9 Handrails

A horizontal handrail on the switchboard front shall provide a safe hold in heavy sea.

324.1.10 Ventilation

Enclosed units shall be ventilated by louvers.

324.1.11 Cable Entry

Switchboards shall be provided for bottom cable entry. The cable sheaths shall be maintained intact to the greatest possible extent, and the cables shall be stripped to the individual conductors only as necessary to form a loop at each end of the wiring trunk to provide adequate flexibility to meet the requirements for bending radius. Cable screens shall be properly grounded through the use of approved cable glands with earthing cones.

Connection of ship cables to switchboards shall be made to permit movement of the section in any direction without subjecting cable connections to severe stress.

324.1.12 Efficiency

Electric equipment shall be selected for the highest operating efficiency that is commensurate with reliability, duty cycle, and requirements of minimum size and weight.

324.1.13 Ambient Conditions

Switchboard equipment shall be dimensioned for engine room temperature of 45°C and 40°C for others areas.

324.1.14 Equipment Enclosures and Protection

The equipment enclosures are such that the equipment performs its intended function satisfactorily in the environment in which it is to operate and according to the rules of the Classification Societies.

324.1.15 Operating Conditions

Electrical machinery and equipment shall be designed to operate satisfactorily under

the ship's operating conditions.

324.1.16 Accessibility for Maintenance and Operation

Clearance shall be provided in the immediate vicinity of electrical equipment and machinery to permit complete accessibility for operation, maintenance, repairs, renewal of fuses, and testing.

324.1.17 Protection Devices

Each unit of equipment and all circuits shall be protected from short circuit currents and thermal overloads. The selection, arrangement, and performance of the various protective devices shall provide a complete, coordinated protective system.

The protection devices shall be integrated into the relevant units of the electric plant such as main switchboards and distribution boards.

324.1.18 Short Circuit Protection

Short circuit protective devices applied to the ships service power generation and distribution shall be selected according to the following criteria:

- The rated interrupting capacity of each short circuit protective device shall be equal to or greater than the maximum available initial symmetrical fault current at the point of application.
- The rated making capacity of each circuit breaker shall be equal to or greater than the available peak asymmetrical short circuit current at the point of application.
- The peak through-fault capacity of each device shall be at least equal to the available peak asymmetrical fault current at the point of application.
- Circuit breakers with an interrupting capacity less than the available transient fault current shall be protected by means of line- side connected fuses of suitable interrupting capacity.
- The short circuit protection of the ship service power distribution system shall be selective. This selectivity shall ensure that only the breaker closest to the fault opens under short circuit to ensure maximum continuity of service. The clearing times of series connected protective devices shall be properly coordinated.

324.1.19 Overload Protection

The inverse current-time characteristics of overload protective devices shall be properly coordinate with the thermal characteristics of the electrical plant to be protected.

324.1.20 Selection of Protective Devices

Short circuit protection shall be provided for each unearthed conductor. The rated current of individual loads or the calculated maximum demand current of load groups shall be used in the determination of circuit overload and short circuit protection by fuses of circuit breakers accordingly.

324.1.21 Generator Reverse Power and Overload Protection

Reverse power protection shall be provided for generators which operate in parallel to prevent damage to the prime mover in event of loss of prime mover power. This device shall sense the generator current in all three phases and the reverse power in one phase. It shall generate selective tripping commands when set points are exceeded. It shall provide separate adjustment for reverse current and time delay settings and for overload and time delay settings.

324.1.22 Protection of Personnel

Electric equipment and machinery shall have suitable barriers or screens wherever required to protect personnel from contacting energized, moving or rotating parts. Male plug connectors shall be wired to be de-energized when unplugged.

Hardware selection shall be according to the rules of the Classification Societies.

324.1.23 Insulation Monitoring

Insulation fault monitors shall be permanently installed in the ship-service power distribution systems and in each galvanically isolated special distribution subsystem.

All primary and secondary supply systems above 50 volts shall be galvanically isolated and the insulation resistance to ground of all such systems continuously monitored.

The insulation monitoring system basically shall comprise:

- Insulation fault detectors with indicators for indicating ground to phase insulation conditions (fault) on each phase of the main 3 phase AC 380V 50Hz bus sections.
- Insulation fault detectors with indicators for indicating ground to phase insulation conditions (fault) on each phase of the main 3 phase AC 440V 60Hz bus sections.
- insulation fault detectors complete with fault indicator light to indicate ground conditions on each of the 3 phase AC 115V 60Hz sub-networks
- Insulation fault detector complete with fault indicator and remote indication/test unit for the AC 230V 50Hz hospital sub-network
- The insulation fault detectors shall be connected to the integrated control and monitoring system (IPMS) by field bus for central monitoring.

324.1.24 Cable Connection (Bus Tie)

The main switchboards located in two different autonomous zones are connected by power cable for utmost redundancy (Bus Tie).

324.1.25 Operation

Manual Operation

In manual mode the generator sets shall be started and stopped directly from the main switchboards by pressing the corresponding pushbuttons. A synchronizations device shall be provided to prevent switching in phase opposition.

The main switchboards shall provide for the following:

- Local control of generators and parallel operation of generators for ship service power supply
- Local control of shore connection
- Local control of bus ties
- Distribution of 400V, 3 phase, 50Hz ship service power

Automatic Operation

The ship service generation system shall be arranged to enable automatic remote control by the power management system (IPMS) which is an independent function of the integrated control and monitoring system (IPMS). For further details please refer to separate specification sections.

324.1.26 Power Switchboards

Power switchboards design as described for the main switchboards above shall distribute electric power in radiated form the ship service switchboards to sub-distribution groups or individual electric loads both vital and non-vital, covering the voltage systems required.

Power switchboards shall contain molded case circuit breakers (MCCB) or switches and fuses respectively in number and frame size as required.

Power switchboards shall be supplied with alternative sources of power with automatic transfer switches as appropriate to ensure continuity of service. Under normal service conditions the power switchboards shall be fed from the closest ship service switchboard and any interruption of power from this switchboard shall initiate an automatic transfer to the alternative supply from the other ship service switchboard. Each unit shall be provided with a selector switch 'Automatic-Main Supply-Alternative Supply-OFF' to facilitate control. The incoming supply shall be provided with an ammeter and current transformer in single phase.

The 24VDC sections of the power switchboards shall include batteries and chargers.

The power switchboards shall be developed to suit the number and approved rating of the electrical equipment to be installed. Each power switchboard shall be installed on shock mount.

324.2 Sub-Distribution Switchboards

Sub-distribution switchboards shall be installed on shock mounts.

324.2.1 Lighting Panel Boards

Sufficiency lighting panel boards shall distribute electric power from the main groups to individual loads and lighting system.

Sub-distribution boards shall contain molded case circuit breakers, miniature circuit breakers, or switches and fuses respectively in number and frame size as required.

Sub-distribution panels shall be located centrally in the load concentration area or in close proximity to the dedicated loads.

324.2.2 Hospital Panel

One power distribution panel designated for hospital equipment shall be readily accessible to medical personnel.

The hospital group shall distribute electric power from the main groups to individual hospital consumers.

The hospital group shall be located centrally in the load concentration area or in close proximity to the dedicated loads and features external insulation monitoring for medical spaces.

324.2.3 Galley Panel

One wall mounted stainless steel power distribution panel designated for galley equipment shall be readily accessible to galley personnel.

The galley group shall distribute electric power from the main groups to individual galley consumers.

The galley group shall be located centrally in the load concentration area or in close

proximity to the dedicated loads.

Temperature thermostats and fire sensors connected to a shunt trip breaker to isolate the deep fat fryer in case of over temperature or fire in the deep fat fryer.

For portable kitchen equipment, switched sockets shall be provided.

All other galley consumers shall be permanently connected to the galley group.

324.2.4 Test Panel

One wall mounted test panels shall providing testing facilities for all voltage systems shall be provided for the electronics and electricians workshops.

324.2.5 Laundry Panel

One power distribution panel designated for laundry equipment.

The laundry group shall distribute electric power from main groups to individual laundry consumers.

The laundry group shall be located centrally in the load concentration area or in close proximity to the dedicated loads.

324.3 Switch, Socket and Plug

The Switches, Sockets and Plugs shall be 220VAC 50Hz, 10 A. water proof type IP65 for outdoor and IP44 for machinery room and general outlet for indoor according to the minimum requirement in accordance with the rules of the Classification Societies.

324.4 Junction Boxes

Junction boxes shall be provided according to the minimum requirements in accordance with the rules of the Classification Societies.

325 SHORE PANEL / ASSOCIATED EQUIPMENT

325.1 Shore Panel

Shore power connections, manufactured by Siemens, shall be provided. The receptacle and associated cables shall be protected by an electrically operated circuit breaker. A receptacle control switch shall be provided to open the associated circuit breaker whenever the receptacle cover is opened or the plug removed. The shore power system shall be arranged to enable import of power from a shore based source or another ship alongside and export of power to another ship alongside.

Two shore connection boxes with phase sequence switching, each having rating power according to harbor load condition, shall be provided. They shall be located on main deck at both sides of the vessel where they are specially protected against the environment. The shore connection breakers shall be of the same type as the generator circuit breakers.

The Shore connection boxes shall contain suitable protection devices, to protect the shore supply cable, phase rotation indication, and safety closing interlocks.

Shore connection box no.1 shall be permanently connected to main switchboard fwd which shall include one shore connection circuit breaker.

Shore connection box no.2 shall be permanently connected to main switchboard aft which shall include one shore connection circuit breaker.

The shore connection boxes shall be accessible from both sides of the ship.

The shore connection boxes shall be provided for bottom cable entry.

The shore connection boxes shall be IP56 and suitable covers shall be provided.