

NOTÍFICADO DE:  
 MILTON DE LIMA PINHEIRO  
 Capitão de Fragata (EN)  
 Superintendente Técnico

EDUARDO GAYER DOS SANTOS  
 Capitão de Fragata (EN)  
 Chefe do Departamento de Sistemas Mecânicos

ASSINADO DIGITALMENTE

## BRAZILIAN NAVY NAVAL ENGINEERING DIRECTORATE



PROJECT :				PHASE:		
DISCOUNT DOC.: <b>PURCHASE SPECIFICATION</b>				CODE PHASE:		CYCLE:
DOCUMENT CODING						DATE OF DOCUMENT
CONTROL	DOCUMENT TYPE	SHIP/CLASS	SWBS	SEQ.	LT.	
<b>DEN</b>	<b>832/7</b>	<b>G40</b>	<b>311</b>	<b>001</b>		<b>07/19/2023</b>
DOCUMENT TITLE						
<b>"BAHIA" LANDING PLATFORM DOCK SHIP - PURCHASE OF FOUR (04) DIESEL GENERATOR SETS</b>						
DEGREE OF CONFIDENTIALITY:		RESPONSIBLE:			DEPARTMENTS:	
<b>UNCLASSIFIED</b>		LT(NE) <b>FELIPE FRANCO SANTANA FELIX</b> LT(NE) <b>CLARA DA SILVA COSTA</b> LCdr (NE) <b>HUGO LEONARDO CAMPELLO DE OLIVEIRA</b> LT(NE) <b>RONEI ERLACHER</b>			<b>DEN-22</b> <b>DEN-23</b> <b>DEN-24</b>	
<b>S</b>	APPROVED DATE	END. FILM	IDENTIFICATION OF VESSEL(S)		DIST.	EST. DOC
<b>U</b>	<b>09/11/2023</b>		-----			<b>AP</b>
MARCELO <b>CYRINO DE OLIVEIRA</b> Captain (R) Head of Technical Coordination Department DEN-21		MATTERS		CHRISTIANO FREIRE <b>BARBOSA</b> Lieutenant-Commander (NE) Head of Electrical and Automation Systems Department DEN-24		
ORIGINAL DOCUMENT NUMBER			INSTITUTION NAME		CONTRACT No.	
			<b>DEN</b>			
SUMMARY :						
<p style="text-align: center;">This document establishes the technical requirements applicable for obtaining four (04) Diesel Generator Sets for the “Bahia” Landing Platform Dock Ship.</p>						

**BRAZILIAN NAVY**

**NAVAL ENGINEERING DIRECTORATE**

**TECHNICAL SUPERINTENDENCE  
(DEN-20)**

**DEPARTMENT OF HULL SYSTEMS  
(DEN-22)**

**DEPARTMENT OF MECHANICAL SYSTEMS  
(DEN-23)**

**DEPARTMENT OF ELECTRICAL AND AUTOMATION SYSTEMS  
(DEN-24)**

**TITLE: "BAHIA" LANDING PLATFORM DOCK SHIP – PURCHASE OF FOUR (04)  
DIESEL GENERATOR SETS.**

**PAGE SUMMARY**

<b>1 PURPOSE .....</b>	<b>1</b>
<b>2 BIBLIOGRAPHICAL REFERENCES .....</b>	<b>1</b>
<b>3 LIST OF ACRONYMS AND ABBREVIATIONS .....</b>	<b>1</b>
<b>4 DEFINITIONS .....</b>	<b>1</b>
<b>5 OBJECT OF THE SPECIFICATION .....</b>	<b>2</b>
<b>6 ACQUISITION DESCRIPTION .....</b>	<b>2</b>
<b>7 RESPONSIBILITIES .....</b>	<b>12</b>
<b>8 APPLICABLE REQUIREMENTS .....</b>	<b>13</b>

**ANNEXES:**

**A - LIST OF REQUIREMENTS**

**B - APPLICABLE STANDARDS**

## 1 PURPOSE

To specify requirements applicable to the acquisition of four (04) Diesel Generator Sets for the “Bahia” Landing Platform Dock Ship.

## 2 BIBLIOGRAPHIC REFERENCES

- a) DIRETORIA DE ENGENHARIA NAVAL, ENGENALMARINST nº 05-03A: Abreviaturas e Definições de Terminologia de Engenharia e Construção Naval, Rio de Janeiro;
- b) HIRSHORN, Steven R.; VOSS, L.; BROMLEY, L. NASA systems engineering handbook, Rev 2, National Aeronautics and Space Administration (NASA), Washington, 2016.

## 3 LIST OF ACRONYMS AND ABBREVIATIONS

Table 1 - List of Acronyms and Abbreviations.

ASTM	American Society for Testing and Materials
BN	Brazilian Navy
CODEMP	Código da Empresa (Company Code)
DGS	Diesel Generator Set
DEN	Diretoria de Engenharia Naval (Naval Engineering Directorate)
EMI	Electromagnetic Interference
IEC	International Electrotechnical Commission
IP	Ingress Protection
ISO	International Organization for Standardization
LCP	Local Control Panel
NATO	North Atlantic Treaty Organization
NCAGE	NATO Commercial and Government Entity
NCB	National Coding Bureau
NCS	NATO Coding System
NSN	NATO Stock Number
SPDT	Single Pole Double Throw
LITEQ	Lista de Item por Equipamento (Item List for each Equipment)

## 4 DEFINITIONS

Table 2: Definitions.

Term or expression	Definition
Certificate of inspection	Document attesting that an inspection was carried out, recording the summary of the results obtained, as well as the designation of the material or equipment inspected and the number of the Inspection Procedure or Inspection Form to which the Certificate belongs, according to the reference <u>a</u>
Test certificate	Document analogous to a Certificate of Inspection for Tests, in accordance with reference <u>a</u>
Contractor	An individual or legal entity that signs a contract with the Public Administration. In a broad sense, any firm that intends to be contracted by the Public Administration, in accordance with the reference <u>a</u>

Term or expression	Definition
Test forms	Documents that define test procedures applicable to equipment, subsystems and systems, in accordance with the reference <u>a</u>
Quality warranty	Set of planned and systematic actions that focuses on practically all aspects of the intervening organizations (designers, manufacturers, suppliers, among others) in order to maximize the probability that a product or service will have the specified quality, according to the reference <u>a</u>
Inspection	Set of examinations, measurements and tests, that aim to verify one or more characteristics of an equipment or system construction (geometry, weight, shape, color, materials, finishing, others), comparing them with the requirements specified, in accordance to the reference <u>a</u>
Proof	Test or set of tests carried out on board (on the pier or at the anchorage, and sea) that aim to verify the functioning of equipment and systems installed, and the ship as a whole, comparing them with those contractually established, according to the reference <u>a</u>
Test	Use of a final product to obtain detailed data for performance verification or validation, or to provide sufficient information to verify or validate performance through a more in-depth analysis, in accordance with reference <u>b</u>
Validation	Demonstration that the product fullfils the intended purpose based on stakeholder expectations as per reference <u>b</u>
DGS	It consists on a set of diesel engine and electric generator for the energy production

## 5 OBJECT OF THE SPECIFICATION

This Specification involves supplying:

- a) Four (04) DGS 440V/60Hz, three phase and continuous regime for naval use, ready for installation on board, with nominal characteristics defined in Annex A, with all associated subsystems, equipment, components, accessories, instruments and Local Control Panels (LCP), one for each DGS;
- b) The required accessories to allow the connections between the DGS and their respective LCP.

## 6 ACQUISITION DESCRIPTION

### 6.1. Deliveries

The deliveries provided are divided in three categories: documentation, materials and other deliveries.

### 6.1.1. Documentation

a) The planning for delivery of the following contractual documents set is shown in Table 3:

- (i) Technical Documentation;
- (ii) Integrated Logistic Support Documentation; and
- (iii) Quality Assurance Documentation.

Where:

- (i) E - Delivery of the object of supply; and
- (ii) Ai - Document submission to the BN, where index "i" is the number of months elapsed after the effective date of the contract.

b) The CONTRACTOR must use the document titles indicated in Table 3. If this is not possible, it must prepare a mailing list, observing the equivalence with those mentioned in Table 3;

c) For the documents indicated in Table 3, BN will require their approval on two separate occasions: firstly just after the conclusion and following the application; secondly, the approval will require the correct fulfilling of the inspection, test and proof document.

Table 3: Document delivery schedule.

DOCUMENT SUPPLY SCHEDULE		DOCUMENTS
Ai	E	
		<b>1. TECHNICAL DOCUMENTATION</b>
		<b>1.1. DIMENSIONAL AND INSTALLATION DRAWINGS</b>
A2	E	1.1.1. Diesel engine
A2	E	1.1.2. Generator
A2	E	1.1.3. Transition part (gas discharge) - Diesel engine
A2	E	1.1.4. Expansion joint (gas discharge) – Diesel engine
A2	E	1.1.5. Diesel Generator Set
A2	E	1.1.6. Flexible shims – Groups
A4	E	1.1.7. Local Control Panel
A4	E	1.1.8. DGS main view drawings
A4	E	1.1.9. Generator Voltage Regulator components physical arrangement
A4	E	1.1.10. Diesel engine – Interface with support system
A4	E	1.1.11. Generator – Interface with support system
A4	E	1.1.12. Manual crankcase exhaust pump - Diesel Engine

<b>DOCUMENT SUPPLY SCHEDULE</b>		<b>DOCUMENTS</b>
<b>Ai</b>	<b>E</b>	
A4	E	1.1.13. Fresh water preheating unit – Diesel engine
A4	E	1.1.14. Bearings, rotary rectifier and generator thermometer
A6	E	1.1.15. Flexible coupling
A6	E	1.1.16. Flexible connections
A6	E	1.1.17. Instruments – Diesel engine
A6	E	1.1.18. Instruments - Generator
		<b>1.2. DIAGRAMS</b>
A4	E	1.2.1. Fuel oil – Diesel engine
A3	E	1.2.2. Diagram of the electrical circuit interconnecting instrumentation sensors - Diesel engine
A3	E	1.2.3. Electrical diagram - Generator and exciter
A3	E	1.2.4. Electrical diagram - Voltage regulator
A3	E	1.2.5. Electronic circuit diagram of generator
A3	E	1.2.6. Diagram of internal and external DGS connections
A4	E	1.2.7. Lubricating oil - Diesel engine
A4	E	1.2.8. Cooling fresh water – Diesel engine
A4	E	1.2.9. Raw water – Diesel engine
A4	E	1.2.10. Diesel engine protection devices and systems diagram
A4	E	1.2.11. Electrical connections - DGS/LCP
		<b>1.3. OTHERS</b>
A2		1.3.1. DGS pre-start operation description
A3	E	1.3.2. Raw water pump curves
A3	E	1.3.3. Efficiency generator curve
A3	E	1.3.4. Diesel engine specific fuel consumption curve
A3		1.3.5. Calculation report and respective curves for checking the short-circuit current maintained by the generator
A3		1.3.6. Diesel generator set torsional vibration calculation report
A3	E	1.3.7. Class Certificate of IACS membership for DGS/LCP marine application
		<b>2. LOGISTIC SUPPORT DOCUMENTS</b>
A3	E	2.1. Listing documentation

<b>DOCUMENT SUPPLY SCHEDULE</b>		<b>DOCUMENTS</b>	
<b>Ai</b>	<b>E</b>		
A4	E	2.2.	Service instructions for DGS accessories
A4	E	2.3.	DGS storage instructions
A4	E	2.4.	Diesel engine manual
A4	E	2.5.	Generator manual
A4	E	2.6.	Speed governor manual
A4	E	2.7.	Voltage regulator manual
A4	E	2.8.	Injection pump manual
A4	E	2.9.	Turbo compressor manual
A6	E	2.10.	Fluid specification – Engine coolant, lubricating oil, fuel oil – Diesel engine
A6	E	2.11.	DGS installation manual
A6	E	2.12.	List of Special Tools, Special Testing Equipment and Special Testing Instruments – Diesel Engine
A6	E	2.13.	List of special tools, special test equipment and special test instruments – Generator
A6	E	2.14.	Diesel engine LITEQ
A6	E	2.15.	Generator LITEQ
A6	E	2.16.	LCP LITEQ
A6		2.17.	Proposal for on-board/base spare parts
<b>3. QUALITY ASSURANCE DOCUMENTATION</b>			
A2	E	3.1.	Certification of vibration resistance
A2	E	3.2.	Terminal connections list for diesel engine measuring instruments
	E	3.3.	Certification of Generator Ingress Protection (IP)
A2	E	3.4.	Instruments specification sheet
A3	E	3.5.	Gas emission test procedure
A4		3.6.	Manufacturer comprehensive index of diesel engine inspections and tests
A4		3.7.	Manufacturer comprehensive index of generator inspections and tests
A4	E	3.8.	DGS Factory Test Forms
A4	E	3.9.	DGS Harbor Test Form
A4		3.10.	Inspection and testing programs

DOCUMENT SUPPLY SCHEDULE		DOCUMENTS
Ai	E	
A4	E	3.11. GDS and LCP coating report
A6		3.12. DGS receipt inspection procedure
A6	E	3.13. DGS mechanical balancing report
A6		3.14. Purchased materials/components specifications
	E	3.15. Instruments lists
	E	3.16. Inspection and testing certificates
	E	3.17. Inspections and tests reports

#### 6.1.1.1. Technical Documentation Content

- a) Dimensional and internal arrangement drawings:
- (i) Main dimensions;
  - (ii) Dimensioning drawings of accessories or components;
  - (iii) Dimensioning drawings necessary for the correct shape definition;
  - (iv) Internal arrangement of electrical and mechanical components.
- b) Drawings:
- (i) Able to clarify the understanding of the operation of the system and the function of each equipment, components and accessories. In the case of fluids conducting systems, it should indicate the flow direction in the pipes and interconnections new equipment onboard;
  - (ii) Nominal design values (pressure, temperature, flow, voltage, current, among others) of each component must be indicated; and
  - (iii) All instruments and devices must be represented.
- c) Electrical connection diagrams:
- (i) Terminal strips of the interconnected equipments and accessories;
  - (ii) Driver's data identification;
  - (iii) Interconnected equipment and its location;
  - (iv) The function of each connection;
  - (v) Description of the procedures to be followed during the installation and operation of the equipment, reducing the possibility of EMI occurrence due to their particularities
- d) The equipment installation drawings must contain, at least, the following information:
- (i) Necessary spaces for operation and maintenance;



- (ii) Detailing drawing of flanges, couplings and all parts connecting to other equipment, components or accessories, including orifice draws, material specification and instructions necessary for tightening screws;
  - (iii) Material specification (including the associated standards) for the piping integrated to the equipment and its connections, flanges, gaskets, screws and union nuts;
  - (iv) Detailing drawing of the equipment fastening to the ship's foundation, including: specification of the material, mechanical characteristics, diameter, thread and pitch of the fastening screws; recommended torque and bolt tightening instructions; and foundation horizontality requirements;
  - (v) Information about alignment with other equipment, accessory or component;
  - (vi) Full information about interface connections and unions with support systems, indicating the patterns, dimensions and detail of each union and its placement in the equipment, component or accessory;
  - (vii) Material specification, indicating associated standards.
- e) Instrument specification sheets for the supplied instruments must be provided, as well as technical standard applied to calibration of each instrument;
- f) Justification and calculation reports:
- (i) They must contain the information gathered, the calculations performed, indicating the hypotheses, requirements, criteria, graphs, tables, formulas and normative references in order to allow the understanding, eventual reconstitution and verification;
  - (ii) The criteria used for the main materials/components selected by the CONTRACTOR, must be presented.
- g) Project description must include the specification of the equipment, protection devices, cables and other components integrated to the electrical system, including command, control and signaling circuits of the DGS.

#### **6.1.1.2. Integrated Logistic Support Documentation Contents**

- a) Technical manuals:
- (i) General description and characteristics of the equipment;
  - (ii) Operating instructions under normal, special and emergency conditions, including safety precautions;
  - (iii) Maintenance plans with detailed procedures, frequency of the planned routines, including the list of spare parts, test equipment and special tools used, as well as the applicable safety precautions;
  - (iv) Instructions for equipment assembly and disassembly, including torques and adjustment values;
  - (v) Necessary calibrations and adjustments, with detailing procedures ;

- (vi) Troubleshooting table, which shall list the most common problems, main causes and the adequate corrective actions;
  - (vii) Spare parts list;
  - (viii) List of equipment parts and components containing the reference number and manufacturer for each item.
- b) Proposal for onboard and base spare parts containing the allocation required for a period of 3 months and two years respectively. The list must contain the respective manufacturer's reference number for each item.
- c) Training Plan for each level of training of the workforce (onboard or naval base/shipyard), covering installation, operation, repair and maintenance on board.
- d) Cataloging documentation containing the list of onboard spare parts, base spare parts and special tools according to the following situations:
- (i) For items that have an assigned NSN code, the following information must be provided: name, name of real supplier, reference number and NSN code. It should be noted that the agency responsible for cataloging will be the NCB, if this is a NATO member country, or affiliated to the NCS;
  - (ii) For items that do not have an assigned NSN code, the following information must be provided:
    - A. Name (technical name and colloquial name, if any);
    - B. Supplier information such as name, trade name (if any) full address (city, state, address, zip code, telephones, fax, e-mail), CODEMP or NCAGE (code assigned to national suppliers or supplier from NATO countries, if applicable) and manufacture code;
    - C. Standards and manufacturing specifications, if not included in the technical documentation;
    - D. Code in which the item appears on the CONTRACTOR's documentation (Parts Catalog);
    - E. Unit price;
    - F. Supply unit;
    - G. Shelf life;
    - H. Storage period;
    - I. Mean time between failures;
    - J. Reparability condition;
    - K. Interchangeability;
    - L. Packed and unpacked weight; and
    - M. Storage space.

- e) LITEQ – list of components, accessories and parts of each equipment (including accessories such as pressure gauges, thermometers, others), in one or more exploded views, containing the reference number, the respective manufacturer and the amount applied. This document shall specify and illustrate the parts of the equipment.
- f) List of special tools and instruments applied to maintenance and the procedure to handle the equipment.
- g) Infrastructure and Support Resources Plan which must provide information about items that shall be available for second and third-level maintenance, such as:
  - (i) Workshops, even if small;
  - (ii) Other Specialty Resources (except Special Tools, Special Testing Instruments, and Special Testing Equipment).

#### **6.1.1.3. Quality Assurance documentation content**

- a) Test forms are documents in which the CONTRACTOR defines, detailed and systematically, the procedures applicable for testing systems, subsystems and equipment. They must contain, at least, the following information:
  - (i) Purpose of the test or proof;
  - (ii) Prerequisites;
  - (iii) Reference documents (drawings and specifications);
  - (iv) Instruments to be used, with their respective calibration certificates;
  - (v) Detailed description of the inspection/test procedure;
  - (vi) Acceptance criteria;
  - (vii) Participating personnel safety prescriptions;
  - (viii) Items to be checked;
  - (ix) Data record sheet; and
  - (x) Test or Proof Certificates (performance and acceptability).
- b) Reports or Certificates of Inspections, Tests or Evidence containing, at least, the following information:
  - (i) Organization responsible for the inspection, test or proof;
  - (ii) Place and date of inspection, test or proof;
  - (iii) Reference standards or normative regulations;
  - (iv) Name, model and serial number of the item submitted for inspection, testing or proof;
  - (v) Type of inspection, test or proof;
  - (vi) Result of the inspection, test or proof;
  - (vii) Corrective actions taken in order to eliminate non-conformity observed;

- (viii) Names and signatures of the person responsible for the inspection or test and other participants.
- c) Coating report containing, at least, the following information:
  - (i) Surface preparation;
  - (ii) Environment conditions during paint application (local temperature, relative humidity and dew point);
  - (iii) Paint application methods (brush, roller or spray);
  - (iv) Paint used for each coat (product name);
  - (v) Dry film for thickness each coat.

### **6.1.2. Materials**

The CONTRACTOR must provide the following materials, meeting the requirements contained in Annex A as well as the technical standards and documents listed in Annex B.

- a) Commissioning spare parts;
- b) Special tools;
- c) Two (02) lubricating oil pressure sensors for each diesel engine;
- d) Two (02) cooling water temperature sensors for each diesel engine;
- e) One (01) expansion joint of the air intake system for each diesel engine;
- f) One (01) absorption silencer of the air intake system for each diesel engine;
- g) One (01) set fuel oil filters duplex type for each diesel engine;
- h) One (01) manual pump to prime the fuel oil system for each diesel engine;
- i) One (01) set of motor pump, LPC and filter of diesel engine pre-lubrication for each diesel engine;
- j) One (01) lubrication oil manual pump for each diesel engine;
- k) One (01) expansion for each diesel engine gas discharge duct;
- l) One (01) transition piece, installed between the turbo-compressor outlet flange and the expansion joint, for each diesel engine;
- m) One (01) engine exhaust muffler (silencer) for each duct;
- n) One (01) set of compressed air and storage ampoules for diesel engine starting system;
- o) One (01) set of accessories to regulate the air compression system applied to start the engine;
- p) Pre-heat system components of diesel engine;
- q) One (01) battery bank of 24Vcc for each LPC;
- r) One (01) heating resistance set, for each generator, aiming to avoid air condensation inside the machine.

### 6.1.3. Other Deliveries

The CONTRACTOR must provide the items listed in Table 4, meeting the requirements contained in Annex A as well as the technical standards and documents listed in Annex B.

Table 4: Description of deliveries.

ITEM	DELIVERIES
1	Complete Diesel-Generator Sets
2	Local Control Panels
3	Technical assistance
4	Commissioning supervision
5	Training for operation and maintenance on board
6	Subsystems, equipment, components, accessories, instruments and Local Control Panels (LCP), one for each DGS
7	Accessories to allow the connections between the DGS and their respective LCP

### 6.2. Inspections and Tests

The CONTRACTOR must carry out the inspections and tests indicated in Tables 5 and 6.

Table 5: Inspections to be carried out.

EQUIPMENT	FACTORY	ONBOARD
<b>DIESEL GENERATOR SET</b>	1. Alignment 2. Receipt	1. Alignment 2. Coating 3. Installation
<b>DIESEL ENGINE</b>	1. Visual	1. Visual
<b>GAS DISCHARGE SYSTEM</b>	1. Visual and Dimensional	1. Visual and Dimensional 2. Installation 3. Thermal Insulation
<b>GENERATOR</b>	1. Visual 2. Dimensional	1. Visual
<b>LOCAL CONTROL PANEL</b>	1. Visual 2. Dimensional 3. Cabling 4. Degree of protection 5. Receipt	1. Visual 2. Coating 3. Cabling 4. Installation

Table 6: Tests to be carried out.

EQUIPMENT	FACTORY	ONBOARD
<b>DIESEL GENERATOR SET</b>	1. Performance 2. Efficiency 3. Vibration	1. Performance 2. Efficiency 3. Vibration

<b>EQUIPMENT</b>	<b>FACTORY</b>	<b>ONBOARD</b>
<b>DIESEL ENGINE</b>	<ol style="list-style-type: none"> <li>1. Test without load</li> <li>2. Cold and normal starts</li> <li>3. Start and stop</li> <li>4. Idling</li> <li>5. Security devices</li> <li>6. Self-excited vibration</li> <li>7. Speed regulator</li> </ol>	<ol style="list-style-type: none"> <li>1. Test without load</li> <li>2. Cold and normal starts</li> <li>3. Start and stop</li> <li>4. Security devices</li> <li>5. Speed regulator</li> </ol>
<b>GAS DISCHARGE SYSTEM</b>	<ol style="list-style-type: none"> <li>1. Backpressure</li> </ol>	<ol style="list-style-type: none"> <li>1. Backpressure</li> </ol>
<b>GENERATOR</b>	<ol style="list-style-type: none"> <li>1. Grounding</li> <li>2. Ohmic resistance</li> <li>3. Dielectric strength</li> <li>4. Insulation resistance</li> <li>5. Voltage regulator</li> <li>6. Voltage balance</li> <li>7. Waveform</li> <li>8. Short circuit</li> <li>9. Temperature rise</li> <li>10. Degree of protection</li> <li>11. Overload</li> </ol>	<ol style="list-style-type: none"> <li>1. Grounding</li> <li>2. Insulation resistance</li> <li>3. Voltage regulator</li> <li>4. Temperature rise</li> <li>5. Overload</li> </ol>
<b>LOCAL CONTROL PANEL</b>	<ol style="list-style-type: none"> <li>1. Dielectric strength</li> <li>2. Insulation resistance</li> <li>3. Starting system</li> <li>4. Security devices</li> <li>5. Control, protection, indication and alarm devices</li> <li>6. Instrumentation</li> <li>7. Phase sequence</li> <li>8. Grounding</li> </ol>	<ol style="list-style-type: none"> <li>1. Insulation resistance</li> <li>2. Starting system</li> <li>3. Security devices</li> <li>4. Control, protection, indication and alarm devices</li> <li>5. Instrumentation</li> <li>6. Phase sequence</li> <li>7. Grounding</li> </ol>

## **7 RESPONSIBILITIES**

### **7.1. CONTRACTOR:**

- a) To fix defects coming from supply and testing that may be detected by BN, even after technical documentation approval;
- b) To update the documents related to systems/equipment that could be modified in accordance to the purpose of this specification;
- c) All instruments to be used in inspections and tests and must be followed by respective calibration certificates. These certificates must be issued by recognized official Organization and within the period of validity. If the certificate is issued by the CONTRACTOR, the applied procedures and standards shall be validated by an official Organization;
- d) To provide, maintain and control the equipment and instruments necessary for Inspections and Tests;

- e) To repeat inspections and tests when nonconformities are detected;
- f) To support costs related to the replacement of partially or totally damaged items derived from inspections or tests;
- g) To indicate a representative to participate in functional tests and performance evaluation of the equipment on board;
- h) To indicate a higher-level employee as representative for contacts with BN;
- i) To keep an organized and updated file, available to BN, that shall contain the contract Quality Assurance documentation, considering the principle of traceability.

## 7.2. BRAZILIAN NAVY

- a) To provide, upon request by the CONTRACTOR, copies of documents and standards on her own responsibility necessary to achieve the Object;
- b) To indicate representatives to participate in the planned inspections and tests;
- c) To indicate technical personnel to participate in inspections and tests included in the Inspection and Test Index or any other activities necessary to comply with the specified requirements.

## 8 APPLICABLE REQUIREMENTS

The requirements applicable to this Specification are described in Annex A.

Prepared by:

**FELIPE FRANCO SANTANA FELIX**  
Lieutenant (NE)  
Structure Division Assistant  
DEN-2223

**CLARA DA SILVA COSTA**  
Lieutenant (NE)  
Materials Division Assistant  
DEN-2232

**HUGO LEONARDO CAMPELLO DE OLIVEIRA**  
Lieutenant-Commander (NE)  
Propulsion Division Assistant  
DEN-2311

**RONEI ERLACHER**  
Lieutenant (NE)  
Generation and Distribution Division Assistant  
DEN-2417

Verified by:

**JEFERSON FERREIRA DE OLIVEIRA**  
Lieutenant-Commander (NE)  
Head of Structure Division  
DEN-222

**IDALBA SOUZA DOS SANTOS**  
Lieutenant-Commander (NE)  
Head of Materials Division  
DEN-223

**SÉRGIO FRANCO CLUME**  
Lieutenant-Commander (NE)  
Head of Propulsion Division  
DEN-231

**FELIPE DA SILVA LAZARO**  
Lieutenant-Commander (NE)  
Head of Generation and Distribution Division  
DEN-241

**BRENNO MOURA CASTRO**  
Lieutenant-Commander (NE)  
Head of Surface Force Ships and Vessels  
Coordination Division  
DEN-212

**ANNEX A****LIST OF REQUIREMENTS**

Table A 1: List of requirements.

<b>Codification</b>	<b>Requirement Description</b>	<b>Verification</b>
<b>GENERATOR</b>		
SE-GEN-001	The nominal power of each generator must be between 900 and 1000 kW	Analysis
SE-GEN-002	The nominal voltage of each generator must be 440 V	Analysis
SE-GEN-003	The nominal frequency of each generator must be 60 Hz	Analysis
SE-GEN-004	The number of phases of each generator must be equal to three (3)	Analysis
SE-GEN-005	The power factor of each generator must be 0.8 inductive	Analysis
SE-GEN-006	The operating regime of each generator must be continuous	Analysis
SE-GEN-007	The generator's insulation must be class F with temperature raise class B, at least	Analysis
SE-GEN-008	The connection diagram of each generator must be star with accessible ungrounded neutral	Analysis
SE-GEN-009	The IP grade of each generator, considering its terminal box, must be at least IP-44	Certificate
SE-GEN-010	The exciter must be a brushless rotary type	Analysis
SE-GEN-011	Rotary rectifiers must be dimensioned so that, during routine operations incidence or extinction of short circuits, the rated voltage and current values of the rectifier diodes are not exceeded	Analysis
SE-GEN-012	Rectifier diodes must be protected against transients caused by sudden load variations	Analysis
SE-GEN-013	Each diode of rotating bridge must have a connection to allow the detection of open or short circuit in one or more diodes	Analysis
SE-GEN-014	The generator's peak short-circuit capacity at no-load and at full load must not exceed 35 kA, when subjected to a three-phase short-circuit applied to its terminals	Analysis
SE-GEN-015	For any balanced load condition the difference between the highest and lowest value of the three line voltages (rms value), for each generator, must not exceed 1% of the average value	Test



SE-GEN-016	The voltage drop at the generator terminals previously loaded with a load of up to 50% of the nominal and power factor equal to 0.8 inductive, must not exceed 15% of the nominal voltage when a load equal to 50% of the nominal power is applied with any power factor between 0 and 0.4 inductive	Test
SE-GEN-017	The voltage variation at the generator terminals must not exceed $\pm 15\%$ of the nominal voltage when applying or removing instantaneous loads that are 25% of its nominal capacity with a power factor equal to 0.8 inductive	Test
SE-GEN-018	In transient variations, the voltage must return and remain within a variation range comprised between $\pm 1\%$ of the final value under steady state in a maximum time of 2 seconds, counted from the instant of load variation	Test
SE-GEN-019	For all load and power factor conditions the line voltage envelope modulation deflection generator's must not exceed 2% of the peak-to-peak value of the rated line voltage	Test
SE-GEN-020	Each generator must be supplied with six (06) thermoresistance type PT100	Inspection
SE-GEN-021	Each winding phase must have two thermoresistance type PT100 (embedded in the windings) for overheating protection and alarm	Inspection
SE-GEN-022	Each PT100 must have its terminals accessible in the generator terminal box	Analysis
SE-GEN-023	Each generator must be capable to withstand 10% overload of its rated power for at least one hour every twelve hours of operation	Test
<b>DIESEL ENGINE</b>		
SM-ENG-001	The diesel engine must be free of any magnesium alloy parts	Analysis
SM-ENG-002	Fuel oil must be pumped from the service tank through a pump independent of the diesel engine	Analysis
SM-ENG-003	The independent fuel oil pump must have a filter at its inlet and outlet	Analysis
SM-ENG-004	Lubricating oil drainage from the diesel engine crankcase must be carried out by a manual pump	Inspection
SM-ENG-005	The diesel engine discharge gases must be conducted to the atmosphere from the engine outlet by an individual duct, through the chimney	Inspection
SM-ENG-006	The diesel engine air system must be designed for intake air temperature of $+45^{\circ}\text{C}$	Analysis
SM-ENG-007	The diesel engine systems must be designed for maximum engine room temperature of $+55^{\circ}\text{C}$	Analysis
SM-ENG-008	The diesel engine systems must be designed for minimum engine room temperature of $+5^{\circ}\text{C}$	Analysis
SM-ENG-009	The diesel engine systems must be designed for barometric pressure of 1013 mbar	Analysis

SM-ENG-010	All diesel engine systems must be designed for relative humidity of 70%	Analysis
SM-ENG-011	The diesel engine coolant system must be designed for minimum raw water temperature of 0°C	Analysis
SM-ENG-012	The diesel engine coolant system must be designed for maximum raw water temperature of +32°C	Analysis
SM-ENG-013	The diesel engine coupling must be balanced using Multi-plane balancing method	Certificate
SM-ENG-014	The diesel engine must be capable of operating with marine diesel oil, Petrobras standard, with a lower calorific value of 42.3MJ/kg (10,100kcal/kg)	Analysis
SM-ENG-015	The diesel engine must be capable of operating with the lubricants from companies available in Brazil and from the normal supply line	Analysis
SM-ENG-016	Mechanical vibrations must be minimized by static and dynamic balancing of the individual rotating parts as well the complete engine assembly	Analysis
SM-ENG-017	The diesel engine must be coupled to the generator through a flexible coupling that supports the stresses resulting from axial, transverse and torsional vibrations	Analysis
SM-ENG-018	The emission of polluting gases from the diesel engine must allow the ship to navigate through the Emission Control Areas (ECAs)	Certificate
SM-ENG-019	All connections between the diesel engine and its accessories mounted on flexible coupling must be interfaced by flexible joints or hoses	Inspection
SM-ENG-020	The cooler temperature regulation for the combustion air must be automatic	Inspection
SM-ENG-021	All auxiliary equipment of the lubricating oil system must be mounted on the diesel engine or on the common base plate	Inspection
SM-ENG-022	All auxiliary equipment of the cooling system must be mounted on the diesel engine or on the common base plate	Inspection
SM-ENG-023	The expansion joint must be flanged type	Inspection
SM-ENG-024	The expansion joint bellows must be made of AISI 321 stainless steel	Certificate
SM-ENG-025	The expansion joint must have a service life of at least 1,000 cycles	Analysis
SM-ENG-026	The starting valve must be mounted on the diesel engine	Inspection
SM-ENG-027	The starting valve must be electrically actuated	Inspection
<b>DIESEL GENERATOR SET</b>		
SM-DGS-001	The DGS, its accessories and auxiliary equipment must be capable to operate normally and continuously under the conditions of movements and accelerations associated with sea state 5 and wind Beaufort 6, without any loss of performance or efficiency and without occurrence of any deleterious effect	Analysis

SM-DGS-002	The DGS, its accessories and auxiliary equipment must be capable of operating normally and continuously with a band of $\pm 15$ degrees (to either side)	Analysis
SM-DGS-003	The DGS, its accessories and auxiliary equipment must be capable of operating normally and continuously with $\pm 5$ degrees trim (stern or bow)	Analysis
SM-DGS-004	The DGS, its accessories and auxiliary equipment must be capable of operating normally and continuously with $\pm 30$ degrees of play	Analysis
SM-DGS-005	The DGS, its accessories and auxiliary equipment must be capable of operating normally and continuously with a $\pm 10$ degree rebound	Analysis
SM-DGS-006	Each DGS must have a dimensional envelope with the following maximum dimensions: 4500 mm length, 2300 mm width and 2600 mm height	Analysis
SM-DGS-007	The DGS must be mounted on a common base (skid), which allows the movement of the complete set	Inspection
SM-DGS-008	The DGS must be mounted on flexible elastomer shims	Inspection
SM-DGS-009	The coolers must be mounted on the diesel engine or on the common base plate	Inspection
SM-DGS-010	The freshwater expansion tank must be mounted on the diesel engine or on the common base plate	Inspection
SM-DGS-011	The manual pumps must be mounted on the diesel engine or on the common base plate	Inspection
SM-DGS-012	The center of gravity of each equipment must be coincident with the elastic center of the respective flexible shims	Analysis
<b>TERMINAL BOX</b>		
SE-TER-001	The dehumidifier heater must be powered at 115 V, 60 Hz, 2 phases, 2 wires, not grounded	Inspection
SE-TER-002	Any connection of the windings or internal devices of the generator with the external equipment, protection devices, alarm, monitoring or external controls must be made through the terminal box, without the use of welding, through the connection between the terminals of the electrical cables connected to fixed terminals inside the terminal box	Inspection
SE-TER-003	The electrical cables penetration in the terminal box must be done through marine brass cable glands and the terminals used must be pressed type	Inspection
SE-TER-004	The fixing between terminals must be withstand lateral rotation and shall not have any malfunctioning due to vibrations	Inspection
<b>VOLTAGE REGULATOR</b>		
SE-VOL-001	The voltage at the generator terminals must be controlled by an automatically voltage regulator	Inspection
SE-VOL-002	The voltage regulator must allow manual adjustment	Inspection

SE-VOL-003	The voltage regulation system must provide manual adjustment of voltage by $\pm 5\%$ , through commands from the electrical panel	Test
SE-VOL-004	The voltage, variations must be detected and controlled by the regulator and shall be equal to the average of the three line voltages at the generator terminals	Test
SE-VOL-005	For any load between 0% and 100% from the nominal one, with the power factor of 0.8 and at any frequency between 57 and 63Hz, the automatic voltage regulator must not allow the average line voltage at the generator terminals exceeds the limits from $\pm 1\%$ of the generator voltage	Test
<b>SPEED REGULATOR</b>		
SE-SPE-001	The speed regulator must be adjusted so that the nominal frequency of the generator is obtained for a load equal to 50% of its nominal capacity	Inspection
SE-SPE-002	The speed variation in steady state (speed droop), from the zero load condition to the nominal load (and vice versa), must be adjustable from 0 to 5% of the nominal speed	Inspection
SE-SPE-003	For load variations of 25% of nominal, suddenly applied or removed, the momentary speed variation must not be greater than 2.5% of nominal speed	Test
SE-SPE-004	For instantaneous load variations from 0% to 83% from nominal one (and vice versa), the instantaneous variation of speed must not exceed 10% of nominal	Test
SE-SPE-005	The frequency return time to steady state, after a system disturbance, must be less than 2 seconds	Test
SE-SPE-006	Cyclic frequency variations, defined as variations that occur in periods of time between 0 and 10 seconds (frequency modulation), must not exceed 0.5% of rated frequency for any load between 0 and 100% of the generator rated capacity	Test
SE-SPE-007	The speed regulator must allow, remotely, the manual adjustment of the speed in $\pm 5\%$	Inspection
SE-SPE-008	The regulator must be electronic and must be installed in the LCP	Inspection
SE-SPE-009	The speed regulator must be approved for marine use by Classification Society	Certificate
<b>ELECTRIC CABLES</b>		
SE-CAB-001	The electrical cables must be halogen-free	Certificate
SE-CAB-002	Electric cables must have low smoke emission	Certificate

SE-CAB-003	The electrical cables must have flame retardant	Certificate
SE-CAB-004	Electric cables must have low emission of acid gases	Certificate
SE-CAB-005	Electric cables must have low emission of toxic gases	Certificate
SE-CAB-006	Cables must be designed for continuous operation at an ambient temperature of 45°C	Certificate
SE-CAB-007	Cables must be designed for continuous operation at 80% relative humidity	Certificate
SE-CAB-008	Electrical cables for control, communication and instrumentation systems must be shielded, individually and collectively	Certificate
SE-CAB-009	Electrical cables for data and signal transmission must be suitable for use at a continuous operating temperature of 65 °C	Certificate
SE-CAB-010	Electrical cables for data and signal transmission must have a minimum insulation voltage of 500 V	Certificate
SE-CAB-011	The coating of electrical cables for data and signal transmission must be non-flame propagating	Certificate
SE-CAB-012	Electrical cables for data and signal transmission must have 22 AWG or 24 AWG twisted pairs with collective shielding, category 6	Certificate
SE-CAB-013	Electrical cables for data and signal transmission must have collective shielding, category 6	Certificate
SE-CAB-014	The nominal thickness of the cable shield metallic tape must be at least 0.1 mm and the nominal diameter for the copper wires must be at least 0.2 mm	Certificate
SE-CAB-015	Electrical cables for data and signal transmission must have a separation tape under the shield	Certificate
<b>GROUNDING</b>		
SE-GRD-001	All electrical equipment operating at voltages greater than 30 volts must be grounded using metallic conductors (such as ribbons and cables) to the ship's ground potential	Inspection
SE-GRD-002	Electrical equipment rigidly mounted on their bases must be grounded by means of grounding straps	Inspection
SE-GRD-003	Electrical equipment installed on resilient shims must be grounded with laminated straps	Inspection
SE-GRD-004	Electrical equipment that will be mounted on non-metallic bases and bulkheads must have a point to connect to ground potential	Inspection
SE-GRD-005	The grounding cable must have connection terminals at both ends	Inspection

<b>ELECTROMAGNETIC COMPATIBILITY</b>		
SE-EMI-001	The electrical and electronic equipment must meet the emission limits to electromagnetic interference (EMI) established in Table A2	Certification
SE-EMI-002	The electrical and electronic equipment must meet the susceptibility limits to electromagnetic interference (EMI) established in Table A3	Certification
<b>TESTS</b>		
SE-TES-001	The DGS must be put into operation for 4 hours consecutive, with their nominal voltage, frequency and power and with a power factor of 0.8 inductive	Test
SE-TES-002	The steady-state voltage variation tests must be carried out with load applications of 0%-25%-50%-75%-100%, with a power factor of 0.8 inductive	Test
SE-TES-003	For each load step in steady state, the voltage values obtained must comply with the voltage variations established in Table A4	Test
SE-TES-004	In the transient voltage variation test with the generator at 0% of rated power, a load of 50% of the rated current of the generator must be instantly applied, with an inductive power factor of 0.4	Test
SE-TES-005	In the transient voltage variation test with the generator at 50% of rated power, with inductive power factor 0.8, a load of 50% of the generator's rated current should be instantly applied, with power factor 0.4 inductive	Test
SE-TES-006	The sequence of load steps for the transient voltage variation test should be 0%-25%-50%-75%-100%-75%-50%-25%-0% with application and instantaneous removal of 25% load blocks with 0.8 inductive power factor	Test
SE-TES-007	For each load step in the transient voltage variation test, the voltage variations obtained must comply with the variations established in Table A4	Test
SE-TES-008	In the steady-state frequency variation tests, the generator load must be increased in steps of 25% up to the nominal value	Test
SE-TES-009	For each load step in steady state, the frequency values obtained must comply with the frequency variations established in Table A4	Test
SE-TES-010	Frequency variation tests in transient regime must be carried out with the application and sudden removal of a load with a power factor of 0.8 inductive	Test
SE-TES-011	The sequence of load steps for the frequency variation test should follow the sequence: 0%-25%-50%-75%-100%-75%-50%-25%-0%	Test
SE-TES-012	The 10% generator overload test must be performed with a load of 110% of the generator rated power for a period of at least 15 minutes	Test

SE-TES-013	Frequency performance tests of generators in transient regime must comply with the frequency variations established in Table A4	Test
<b>CONTROL, MONITORING AND FUNCTIONAL</b>		
SE-CON-001	The control and monitoring system must be powered at 24 Vdc	Analysis
SE-CON-002	Each LCP must be supplied by the battery bank for a period not less than 30 minutes in the event of a DGS shutdown	Inspection
SE-CON-003	DGS must be controlled both locally and remotely	Test
SE-CON-004	Remote control and monitoring must be done through the electrical panel	Inspection
SE-CON-005	Selection of local/remote operation must be done through a transfer device installed in the LCP	Inspection
SE-CON-006	Each LCP must perform the start-up, normal stop, automatic stop (safety) and emergency stop sequences of the associated DGS	Test
SE-CON-007	When in the LOCAL position, the local/remote transfer device must disable the remote actuation of all remote commands	Test
SE-CON-008	When in the LOCAL position, the local/remote transfer device must enable local commands	Test
SE-CON-009	When in the REMOTE position, the local/remote transfer device must enable the operation of all remote commands	Test
SE-CON-010	When in the REMOTE position, the local/remote transfer device must disable all local commands except for emergency stop	Test
SE-CON-011	Emergency stop must be performed from LCP irrespective of position of local/remote transfer device	Test
SE-CON-012	Monitoring (indications and alarms), local and remote, must always be working, regardless the position of the local/remote transfer device	Test
SE-CON-013	Each DGS must have local devices that make the safety stop (automatic) in the event of high speed (overspeed)	Test
SE-CON-014	Each DGS must have local devices that make the safety stop (automatic) in the occurrence of low speed (underspeed)	Test
SE-CON-015	Each DGS must have local devices that make the safety stop (automatic) in the event of high cooling water temperature	Test
SE-CON-016	Each DGS must have local devices that make the safety stop (automatic) in the event of low lubricating oil pressure	Test
SE-CON-017	Each DGS must have local devices that open the circuit breaker and de-energize the generator in case of overheating	Test
SE-CON-019	Each LCP must have one command to start the DGS	Inspection

SE-CON-020	Each LCP must have one command to stop the DGS	Inspection
SE-CON-021	Each LCP must have one emergency stop command for the DGS	Inspection
SE-CON-022	Each LCP must have one local/remote transfer command	Inspection
SE-CON-023	Each LCP must have the command to turn on the dehumidifier	Inspection
SE-CON-024	The generator command "Turn on dehumidifier " should put the dehumidifier on automatic and should normally remain activated. Thus, the dehumidifier must be de-energized whenever the generator starts and energized when the generator stops	Inspection
SE-CON-025	Each LCP must have one dehumidifier off command	Inspection
SE-CON-026	Each LCP must have one lamp test command	Inspection
SE-CON-027	Each LCP must have one alarm test command	Inspection
SE-CON-028	Each LCP must have one alarm recognize command	Inspection
SE-CON-029	Each LCP must have one panel energize command	Inspection
SE-CON-030	Each LCP must have one command to de-energize the panel	Inspection
SE-CON-031	Each LCP must have one rotation indication	Inspection
SE-CON-032	Each LCP must have one engine cooling water temperature indication	Inspection
SE-CON-033	Each LCP must have one indication of lubricating oil pressure	Inspection
SE-CON-034	Each LCP must have one indication of hours of operation (hour meter )	Inspection
SE-CON-035	Each LCP must have one temperature indication of the discharge gases	Inspection
SE-CON-036	Each LCP must have one battery voltage indication	Inspection
SE-CON-037	The rotation indications must be analogue, even being redundant in a digital indicator	Inspection
SE-CON-038	The temperature indications must be analogue, even being redundant in a digital indicator	Inspection
SE-CON-039	Indications of lubricating oil pressure must be analogue, even being redundant in a digital indicator	Inspection
SE-CON-040	Each LCP must have the status indication of DGS in operation	Inspection
SE-CON-041	Each LCP must have the DGS status indication in stopped operation	Inspection
SE-CON-042	Each LCP must have the status indication of DGS in operation energy available	Inspection
SE-CON-043	Each LCP must have the status indication of the DGS in operation dehumidifier of the generator connected	Inspection
SE-CON-044	Each LCP must have the alarm (visual and audible) to stop due to low speed (underspeed)	Inspection
SE-CON-045	Each LCP must have visual and audible shutdown alarm due to low lubricating oil pressure	Inspection



SE-CON-046	Each LCP must have a stop alarm (visual and audible) due to high cooling water temperature	Test
SE-CON-047	Each LCP must have visual and audible alarm for opening the circuit breaker due to high temperature in the generator	Test
SE-CON-048	Each LCP must have an alarm (visual and audible) for low lubricating oil pressure (this alarm must be set at a higher level than the stop alarm due to low lubricating oil pressure)	Test
SE-CON-049	Each LCP must have the alarm (visual and audible) for high cooling water temperature (this alarm must be set at a lower level than the stop alarm due to high cooling water temperature)	Test
SE-CON-050	Each LCP must have a high temperature (overheating) alarm (visual and audible) on the generator (this alarm must be set at a lower level than the generator breaker opening level in the event of generator overheating)	Test
SE-CON-051	The LCP must have at least IP-44 degree of protection	Certificate
SE-CON-052	The LCP must provide signals to interface with the electrical panel, so that it is possible to reproduce all the commands, indications, status indications and alarms existing in the LCP itself	Analysis
<b>INSTRUMENTATION</b>		
SE-INS-001	All LCP instruments must have a minimum degree of protection IP-44	Certificate
SE-INS-002	All LCP instruments must have a maximum error of 1.0% of the amplitude of the range (span), in the entire range (range), in the indications or performances	Certificate
SE-INS-003	The ranges of the LCP instruments must be selected so that the adjustment points or operating ranges are located in the middle third of the scales	Inspection
SE-INS-004	The LCP dials must be white with black matte markings and digits	Inspection
SE-INS-005	The materials from the instruments and accessories must be compatible with the process fluid and with the materials of the pipes and the elements attached to them	Certificate
SE-INS-006	Small parts such as screws, washers, among others, must be manufactured with corrosion-resistant materials	Certificate
SE-INS-007	All contacts must be SPDT, voltage-free and with a minimum capacity of 5A, 24Vdc and insulation voltage of 120Vac	Inspection
SE-INS-008	Electrical instruments must have electrical connections through terminal blocks	Inspection
SE-INS-009	Electrical instruments must have access through a screwed or threaded cover	Inspection

SE-INS-010	The cables entry and exit in panels must be with cable glands	Inspection
SE-INS-011	The electrical cables from the instrumentation must be mechanically fixed to the equipment	Inspection
SE-INS-012	All electrically powered instruments must have their enclosures grounded	Inspection
<b>COATING</b>		
HS-COA-001	After cleaning and before painting, the surfaces must be free of the contaminants specified in item <u>o</u> of Annex B	Visual
HS-COA-002	Surface treatment by abrasive blasting on steel must be carried out to the almost white metal standard in accordance with item <u>p</u> of Annex B	Visual
HS-COA-003	The steel surface treatment with a mechanical tool must meet the minimum standard St 3 according to item <u>p</u> of Annex B	Visual
HS-COA-004	The aluminium surface treatment must meet the A1 and D1 clean standard according item <u>q</u> of Annex B	Visual
HS-COA-005	Surfaces to be painted must meet the surface preparation level "P3" on corners and edges according to item <u>p</u> of Annex B	Visual
HS-COA-006	The ambient temperature must be greater than 5°C according to item <u>r</u> of Annex B or to the paint manufacturer	Inspection
HS-COA-007	Painting application the substrate temperature must be 3°C above the dew point and below 52°C according to item <u>r</u> of Annex B or to the paint manufacturer	Inspection
HS-COA-008	The relative humidity of the air must be below 85% according to item <u>r</u> of Annex B or to the paint manufacturer	Inspection
HS-COA-009	Painting must be performed in accordance with the overcoating intervals between coats	Inspection
HS-COA-010	The coatings from a given paint scheme must be from a single manufacturer	Certificate
HS-COA-011	Calibrated dry film measuring instrument, capable of measuring thickness with an accuracy of $\pm 10\%$ , must be used.	Inspection
HS-COA-012	The final painting must be free of the defects established in item <u>r</u> of Annex B	Visual
HS-COA-013	The DGS, LCP and other accessories must be coated with the paint schemes described in Tables A5 to A7, or paint schemes with superior performance	Inspection

Table A2 - Limits for Emission to Electromagnetic Interference (item h of Annex B)

Equipment	Frequency	Limits
DGS	150 kHz to 30 MHz 30 MHz to 100 MHz 100MHz to 2000MHz	80 dB $\mu$ V /m to 50 dB $\mu$ V /m* 60 dB $\mu$ V /m to 54 dB $\mu$ V /m* 54 dB $\mu$ V /m*
	except : 156 MHz to 165 MHz	24 dB $\mu$ V /m*
LCP	10 kHz to 150 kHz 150 kHz to 500 kHz 500 kHz to 30 MHz	120 dB $\mu$ V to 69 dB $\mu$ V 79 dB $\mu$ V 73 dB $\mu$ V

\* - measured at 3 meters from the equipment

Table A3 - Limits for susceptibility to electromagnetic interference (item b of Annex B).

Equipment	Frequency	Limits
DGS/ LCP	10 kHz to 100 MHz 100MHz to 18GHz	90 dB $\mu$ V /m to 56 dB $\mu$ V /m 56 dB $\mu$ V /m to 102 dB $\mu$ V /m

Table A4: Limits for voltage and frequency variations (item m of Annex B).

Characteristics	Limits
<b>Voltage</b>	
1 ) Nominal voltage at the user	440V, 220V or 115V (Effective)
2 ) Unbalance between line voltages (three-phase loads)	3%
3 ) User voltage tolerances (in relation to nominal voltage)	
a ) Average of the three line voltages from the nominal	$\pm$ 5%
b ) Value of line voltages, starting from the nominal voltage, including items 2) and 3.a)	$\pm$ 7%
4 ) Voltage modulation	2 %
5 ) Tolerance for voltage transients	$\pm$ 16%
6 ) Worst case user rated voltage variation resulting from 2), 3.a), 3.b), 4 and 5 combined, except under emergency conditions	$\pm$ 20%
7 ) Stabilization time referring to items 5) and 6)	2 seconds
8 ) Peak value of short-term voltage transients	2.5kV ( 440Vrms ) 1.0kV ( 115Vrms )
<b>Voltage Waveform</b>	
9 ) Total harmonic distortion	5%
10) Maximum individual harmonic	3%
11) Deviation factor	5%
<b>Frequency</b>	
12) Rated frequency	60 Hz
13) Frequency tolerance	$\pm$ 3%
14) Frequency modulation	0.5%
15) Frequency transient	$\pm$ 4%
16) Worst case variation from user rated frequency resulting from 13), 14) and 15) combined, except under emergency conditions	$\pm$ 5.5%
17) Frequency transient stabilization time	2 seconds

Table A5 - Paint scheme for electrical panel.

Coating specification*	N° layers	Dry film thickness (Microns)	Color (Munsell)
High adhesion polyisocyanate epoxy primer according	01**	20	***
Solvent-free polyamine epoxy paint, according	02	100	***
Alkyd paint	01	50	****

\* Coatings must be supplied from manufactures that were qualified by the Brazilian Navy;

\*\*Only apply this coat if the substrate is aluminium, stainless steel or other non-ferrous material;

\*\*\* The colors must be different for each coat; and

\*\*\*\* For electrical panel: Grey *Munsell* N-8.

Table A6: Paint scheme for accessories.

Coating specification*	N° layers	Dry film thickness (Microns)	Color (Munsell)
High adhesion polyisocyanate epoxy primer	01**	20	***
Polyamine epoxy holding primer	01	40	***
Polyamine epoxy paint, high thickness, for fuel tanks	01	125	***
Polyamine epoxy paint, high thickness, for fuel tanks	01	125	Grey 10Y 7/1

\* Coatings must be supplied from manufactures that were qualified by the Brazilian Navy;

\*\* Only apply this coat if the substrate is aluminum, stainless steel or other non-ferrous material; and

\*\*\* The colors must be different for each coat.

Table A7: Motor paint scheme.

Coating specification*	N° layers	Dry film thickness (Microns)	Color (Munsell)
Polyamide epoxy rich in zinc, two-component	01	90	**
Thick, high-solids polyamide epoxy	01	110	**
High thickness acrylic polyurethane	02	50	Grey 10Y 7/1

\* Coatings must be supplied from manufactures that were qualified by the Brazilian Navy;

\*\* The colors must be different for each coat.

**ANNEX B****APPLICABLE STANDARDS**

<b>Technical Standard</b>	<b>Title</b>
a) IEC 60092-350	Electrical Installations in Ships – Part 350: General Construction and Test Methods of Power, Control and Instrumentation Cables for Shipboard and Offshore Applications
b) MIL-STD-461G	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
c) IEC 60092-360	Electrical installations in ships - Part 360: Insulating and sheathing materials for shipboard and offshore units, power, control, instrumentation and telecommunication cables
d) IEC 60092-359	Electrical Installations in Ships - Part 359 - Sheathing materials for shipboard power and telecommunication cables
e) IEC 60092-351	Electrical Installations in Ships – Part 351 – Insulating materials for shipboard and mobile and fixed offshore units power, telecommunication and control data cables.
f) IEC 60092-375	General instrumentation, control and communication cables for 60V
g) IEC 60092-352	Electrical Installations in Ships – Choice and Installation of Cables for Low Voltage Power Systems
h) IEC 60533	Electromagnetic Compatibility of Electrical and Electronic Installations in Ships
i) ISO 10816-7	Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts – Part 7: Rotodynamic pumps for industrial applications, including measurements on rotating shafts
j) ISO 20816-1: 2016	Mechanical Vibration - Measurement and Evaluation of Machine Vibration - General Guidelines
k) ISO 8501-1	Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
l) MIL-STD-167-(1) – Type I	Mechanical Vibrations of Shipboard Equipments
m) STANAG 1008: 2004	Characteristics of Shipboard Electrical Power Systems in Surface Warships of the North Atlantic Treaty Navies
n) MARPOL 73/78	Annex VI - Prevention of Air Pollution from Ship
o) SSPC SP1	The Society for Protective Coatings - Surface Preparation Standard No. 1- solvent cleaning

<b>Technical Standard</b>	<b>Title</b>
p) ISO 8501-1	Preparation of steel substrates before application of paints and related products: visual assessment of surface cleanliness. Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
q) ASTM D1730-09	Standard Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting
r) ASTM D 3276	Standard Guide for Painting Inspectors (Metal Substrates)