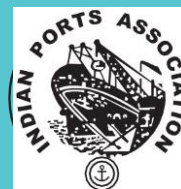




Ministry of Ports,
Shipping and waterways
Government of India



GREEN TUG TRANSITION PROGRAMME (GTTP) PHASE 1

&OT BATTERY ELECTRIC JULII TECHNICAL SPECIFICATION



This specification has been developed for the Indian Ports Association as a part of the Green Tug Transition Programme. The specification does not make any representation or warranties, express or implied as to the completeness, accuracy, suitability of the design and it shall be the responsibility of the respective end-user of the specification to make their own assessment/evaluation of any such completeness, accuracy, suitability of the design before construction and any consequence thereof.

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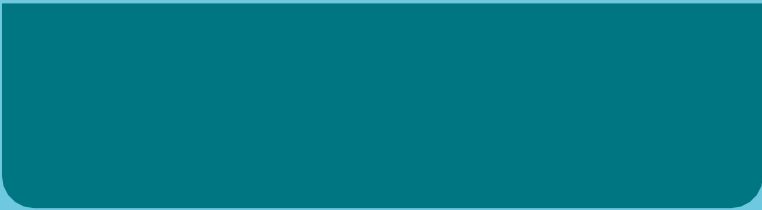


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BACKGROUND

Over the years, the Government of India has announced several initiatives to support the shipping and ports industry, with strong emphasis on reducing emissions and promoting sustainability. In 2015, the government announced the Sagarmala Program, aimed at holistic port infrastructure development through modernization, mechanization and computerization. Further in 2020, the Hon'ble Prime Minister released the Maritime India Vision - 2030 (**MIV 2030**), which is a 10 Year blueprint on India's vision of a sustainable Maritime sector and vibrant blue economy.

MIV 2030 identifies key interventions to bolster India towards leading the world in Safe, Sustainable and Green Maritime Sector. These include targets for increasing the share of renewable energy to 60% of the total power demand of each of its major ports, through solar and wind-generated power. It also envisages a 30% reduction in Carbon emissions per ton of cargo handled by 2030. Further, the vision also urges all the ports to switch 50% of their vehicles to greener fuels by 2030. "Harith Sagar" -Green Port guidelines also gives out targets to make port crafts use cleaner and greener fuels for propulsion.

GTTP TIMELINES

As a first step towards implementation of GTTP, Ministry of Ports, Shipping & Waterways (MoPSW) has mandated that four Major Ports (Jawaharlal Nehru Port Authority (JNPA), Deendayal Port Authority (DPA), V. O. Chidambaranar Port Authority (VOCPA) and Paradip Port Authority (PPA) each operationalize a minimum of two Green Tugs. While the remaining eight major ports, shall operationalize at least one Green Tug each. This re-affirms the commitment of the Govt. towards greener shipping operations and will help encourage the private sector also to participate in the green transition programme.

GTTP is envisaged to be implemented in a phased manner to facilitate smooth transition from existing diesel driven tugs to fully green tugs.

INTENT

The intent of this specification along with the accompanying documents is to describe the guideline requirements and the standards of workmanship of a Battery electric Tug that is to be implemented in the First phase of GTTP. The following 60T specification has been developed based on the operating profiles provided by the following ports

1. Jawaharlal Nehru Port Authority (JNPA)
2. Deendayal Port Authority (DPA)
3. V. O. Chidambaranar Port Authority (VOCPA)
4. Paradip Port Authority (PPA)

The operating profile indicated in this specification has been determined by considering the maximum energy requirement from these four ports. For other ports, the respective operating profiles must be taken into account when determining the appropriate battery size. Also, if the above four ports may change the operating profile considering their future expansion plans.



TUG CONFIGURATION FOR FIRST PHASE OF GTTP

The GTTP program will utilize Battery Electric Tugs in the first phase. These electric tugs will have batteries capable of powering all tug operations, including Full bollard pull. However, a diesel generator will also be on board for Fire Fighting (FiFi) operations, emergencies, and extending the operational range of the tug. Propulsion considered for this vessel constitutes two steerable L-drives/Z-drives located in the aft driven by electrical motors.

Vessels shall be classed with any of the classification societies recognised by SSC in line with DGS recognised organisations and they should have office in India. List of recognised classification societies is placed in Annexure 1. Classification societies shall review designs and provide ASTDS-GTTP Compliant certificates.

NEW DESIGN FOR GTTUG

In cases where the Buyer requires GTTug with any of the following

1. New technology other than battery electric tug
2. Any other alternate propulsion

A separate design conforming to the buyer's requirement may be developed by the respective builder/designer. The vessel shall comply with the specifications, workmanship and quality set out in the General specification of GTTP if the vessel is intended to be operated in Indian ports. These new designs must be presented to the SSC committee for evaluation and GTTP compliance before being classified as ASTDS-GTTP Designs

OVERVIEW OF TECHNICAL SPECIFICATION

This technical specification is set out as three Sections that cover

1. Technical Specification for GOT BP (Bollard Pull) battery electric Tug developed based on the operating profiles of the ports JNPA, DPA, VOCPA and PPA.
2. Format for GTTP compliance declaration and GTTP compliant certificate. GTTP compliance declaration shall be submitted during the tendering process of the port by the bidder. However, GTTP compliance certificate from classification society shall be submitted to the port when the tug is inducted for port operations.

Additional Requirements by Buyer

Any requirements over and above the specifications from the buyer of the vessel can be considered in the design.



SECTION 2

**TECHNICAL SPECIFICATION
FOR 60T TUG**



MAIN GROUP 0

GENERAL



GENERAL

A DESCRIPTIONS

This technical specification document gives equipment specification for 60T BP Tug Electric Tug

Interpretation

Buyer: is port or an organisation making a formal proposal against port's Tender, complying with all the requirement of tender; who own and operate vessel in the ports on charter basis.

Builder: Shipyard who construct the vessel as per the requirement of Buyer.

Primary Functions

The vessel shall be primarily tasked for ship handling and towing operations within harbour.

The tug shall be able to perform the following operations:

Primary Roles:

- Berthing/ Unberthing
- Ship assist operation
- Pushing/Pulling

Secondary Roles:

- Fire-fighting (Optional)
- Oil Spill operation (Optional)
- Personnel/Material Transfer

OPERATING PROFILE

| Operation | Duration per cycle |
|--------------------------------|--------------------|
| Standby | 0 |
| Steaming (max Speed) | 0 |
| Transit Low < 6 KNOTS | 8 |
| Transit High > 6 KNOTS | 40 |
| High Bollard Pull > SST | 20 |
| Medium Bollard Push/Pull (45T) | 15 |
| Low bollard Push/Pull < 25T | 45 |

Total Operation Duration per cycle-128 mins

Number of Cycles per Day-4 Nos

Note: The above profile is indicative and needs to be assessed by individual port as per their requirement and the actual profile data shall be included in the tender document.

Service Life

Generally, the vessel shall have an expected service life of 20-25 years. However, the vessel should comply with statutory & class regulations if any.



B MAIN PARTICULARS

The principal design characteristics of the vessel shall be as follows:

| | |
|-------------------------------|-------------|
| Length overall (excl. fender) | abt. 33.0 m |
| Length B.P | abt. 31.0m |
| Breadth moulded | abt.12.0m |
| Depth moulded | abt. 5.5 m |
| Hull Draft | abt.4.5 m |
| Navigational draught | abt. 5.4 m |
| Gross tonnage | <500GT |

The above stated main particulars are subjected to change as per port requirements & operation limitations and the design of the vessel shall meet all regulatory norms for the port specified requirements.

Note: Hull draft is the distance from baseline to waterline of the vessel. However Navigational draft is summation of hull draft and distance below the baseline to the bottom most point of the hull appendages/propeller in the vessel.

C COMPLEMENT

Complement shall meet the requirements offlag state

D CAPACITIES

Minimum capacities to be provided are as given below:

| | |
|-------------|-----------------------------|
| Fuel Oil | - 75 m ³ |
| Fresh Water | - approx. 25 m ³ |
| Foam | - 10 m ³ |

E PERFORMANCE

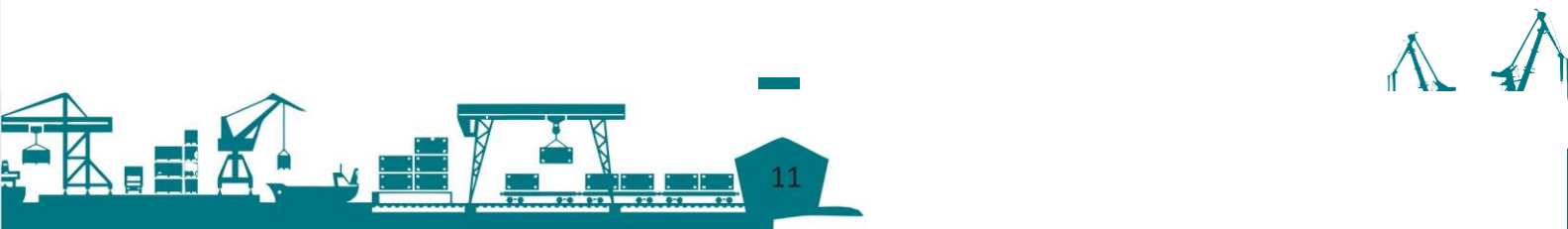
The vessel shall have a static ahead bollard pull of 60T at 100% RPM of thruster during the Bollard pull test.

The vessel shall achieve a speed of approx. 12 knots at design draught with clean hull at 100% RPM of the thruster in calm water and calm weather.

Environmental Conditions

The ship and its equipment and machinery should be capable of continuously operating under the following environmental conditions mentioned below: -

| | |
|--------------------------------|----------------------------|
| Ambient air temperature | : 10°C to 45°C. |
| Machinery room air temperature | : upto 55°C. |
| Sea water temperature | : 32°C. |
| Relative humidity | : 90 % at 35°C. |
| Atmospheric pressure | : 750 mm Hg. (1000 m. bar) |
| Salinity of water | : upto 36000 PPM |



F CLASSIFICATION, REGULATIONS, CERTIFICATES

Classification

The Tug shall be built in accordance with the rules and regulations of the Indian Register of Shipping (IRS) or any other IACS members approved by DGS and according to the following notations:

SUL, IV, TUG, INWATER SURVEY, BATTERY PROP

Optional Notation:

AGNI 1 (2400 m³/hr)

INDIAN COASTAL VESSEL/RSV

or equivalent notations of any other IACS member society. For any optional notations in addition to the above, including INWATER SURVEY, etc., necessary changes in accordance with the respective class notations shall be made by the builder/designer.

Statutory

The vessel shall sail under Indian Flag.

The tug shall be designed and built as river sea vessel or coastal vessel or sea going vessel as per requirement specified by the Port as part of the tender document.

In case the vessel is to be designed and built as River Sea Vessel, then DGS Order 18 of 2013 or its latest amendment as applicable at the time of vessel construction shall be considered.

In case the vessel is to be designed and built as Coastal Vessel, then DGS Order 01 of 2014 or its latest amendment as applicable at the time of vessel construction shall be considered.

In case the Vessel is to be designed as Sea Going Vessel, then Indian MS Rules for sea going ships or its latest amendment as applicable at the time of vessel construction shall be considered.

Note: GA attached along with this specification meets the coastal vessel requirements.

Rules and Regulations

Tug shall be in compliance with all relevant International Standards as applicable at the time of construction, including (but not limited to) the following:

- COLREGS- International Regulations for Preventing Collisions at Sea
- Load Lines, 1966/1988- International Convention on Load Lines, 1966, as Amended by the Protocol of 1988
- MARPOL- International Convention for the Prevention of Pollution from Ships
- Tonnage- International Convention on Tonnage Measurement of Ships, 1969
- 2008 IS Code-International Code on Intact Stability, 2008
- International Labour Conference-Maritime Labour Convention, 2006
- IMO regulations A 468 (Noise levels) and ILO Recommendation R141 as far as practicable for tugs.



- International Convention on the Control of Harmful Anti-Fouling Systems on Ships, 2001
- IACS Rules & Regulation on Battery powered vessels applicable as per class notation

Certificates

The Builder shall obtain following certificates/ equivalent and deliver to the Buyer at the delivery of the vessel.

- a. Certificate of Classification for Hull and Machinery Survey
- b. Bollard Pull Certificate
- c. International Tonnage Certificate
- d. Load Line Certificate
- e. Ship safety Construction Certificate
- f. Ship safety Equipment Certificate
- g. Radio Telephone Certificate
- h. Certificate of Anchors, Chains, Life Saving equipment and Fire Fighting equipment
- i. International Oil Pollution Prevention Certificate
- j. Builder's Certificate
- k. Certificates of anchoring and mooring equipment
- l. Certificates for Compass adjustment
- m. Trim and Stability Booklet
- n. MARPOL Annex IV Sewage Pollution Prevention Certificate
- o. Certificate for towing hook with attachment, towline and towing reel
- p. Letter of Compliance for TBT free, anti-fouling paint issued by paint manufacturer
- q. Statement of compliance for EIAPP for generator engines issued by the Classification Society.
- r. Adjustment certificates for magnetic compass issued by the Builder.
- s. Lifting gear certificate
- t. GTTP Compliant Certificate
- u. All other certificates as required by Class.

G BUILD METHOD AND WORKMANSHIP

Generally, all works shall comply with the requirements of the Classification Society and other Authorities governing this specification.

Steel work to be carried out in compliance with IACS Rec. 047 Part A "Shipbuilding and Remedial Quality Standard for New Construction".

All works shall be carried out in accordance with the approved drawings.

The electrical installation to be according to IEC norms.

All equipment and machinery to be installed according to manufacturer's instructions.

Due care and diligence shall be ensured in protection and cleanliness of all items and equipment being installed in the vessel.

- All materials intended for, or allocated for the construction of the vessel, shall be properly stored or protected from the weather immediately upon arrival at the Builder's yard.



- Electrical, electronic, and interior communication equipment shall be protected against dampness and condensation. Sensitive electronics shall be protected from extreme temperatures as recommended by the OEM.
- Heater elements of electric motors higher than 90 kW should be energized after installation onboard.
- Battery systems shall be stored as per manufacturer's recommendation.

All workmanship for the vessel shall comply with global best shipbuilding practices followed for similar vessels, including the following:

Pre-treatment of materials
 Flame cutting, bending, welding, welding sequence
 Assembling
 Use of tools
 Alignment, fairness, tolerances
 Launching, testing & fitting-out practice
 Temporary access openings
 Building sequence, application of modules, pre-outfitting, painting etc.

MATERIALS

Materials used for building and construction of the vessel, shall be as described below:

- All materials, machinery, equipment, appurtenances, and outfit which are supplied by the Builder shall be new, good commercial quality, and carefully selected for the purpose they are intended to serve.
- Material and equipment shall be procured from recognized manufacturers and shall satisfy the requirement of the Rules and regulations in force.
- Neither asbestos nor asbestos containing material shall be used in construction of the vessel.
- Wherever stainless steel is mentioned, seawater resistant stainless steel such as 316L to be used.

J NOISE & VIBRATION CONTROL

Special consideration shall be given to limit the noise levels within the vessel to a level as prescribed in MSC 337(91) (Noise levels) and ILO Recommendation R141 as far as practicable for tugs, by means of suitable sound insulation and isolation. Special attention shall be paid to keep the noise levels within the prescribed levels for crew cabins adjacent/close to machinery spaces.

Vibration limits in accommodation spaces and other work areas shall conform to ISO 21984:2018 at free running speed, as applicable for this type of vessel. However, the requirements from the Buyer regarding vibration levels shall also be taken into consideration.

Special attention shall be taken to limit the local vibrations from main machinery and other equipment such that these vibrations do not cause any malfunction or damage to the equipment when the vessel is in service.



K DRAWINGS

General

Required documentation to Regulatory Authorities, Classification Society and Buyer shall be handled by the Builder.

All documentation shall be in English language. Method of drawing including the scales to suit Builder's standard practice.

Buyer Approval

Builder shall submit, to the Buyer a set of Classification Documents for their approval. The method of submission and schedule for the approval of the drawings shall be decided by the Buyer and Builder separately before commencing the project.

Classification Documents

Builder shall prepare and submit for approval to Classification Society all documents that mandate Class approvals. Builder is obligated to incorporate all comments and remarks made by Classification Society.

Documents to be provided at delivery of the vessel

The Builder shall hand over at least the following drawings and manuals to the Buyer at the time of delivery of the vessel.

- General Arrangement Plan
- Final Stability Booklet
- Midship Section
- Transverse Sections including bulkheads
- Shell Expansion Plan
- Profiles & Deck Plan
- Superstructures/ Deck Houses
- Skeg Structure
- Docking Plan
- Machinery and Propulsion Arrangement
- Piping diagram schematic
- Navigation Lights and Sound Signals Plan
- Life Saving Appliances Plan
- Fire Fighting Plan
- Electrical Single Line Diagram
- Electrical Wiring Diagram
- Electrical Equipment Arrangement
- General Service and Radio Service battery load Analysis
- Electrical Load Analysis
- Wheelhouse Arrangement
- Accommodation Plan



Sounding Tables
Towing Arrangement
Aft end structures
HVAC and E/R ventilation
Arrangement of Sea chest
Propeller drawing
Arrangement of Battery room
Battery Management System
Power/Energy Management System
Hazardous Area Plan
Operation & Maintenance Manual for battery system
Risk Assessment documents as reviewed by Class.
List of Machinery, Equipment and Plants of Third Parties' Supply, with following Details:
name of manufacturer, address, telephone no.

The list however, is non exhaustive and at the time of signing the Shipbuilding Contract, any additional documents, if found necessary by the Buyer may be included to firm up the final list of Delivery documentation.

In addition, any drawing that needs to be displayed on the vessel as per Class or Regulatory Authority guidelines shall be properly framed and placed onboard the vessel by the Builder.

Instruction Books

Instruction books of the vessel's major machinery, i.e., Main Battery system, Azimuth Thrusters, Generators and other major equipment and systems shall be furnished to the Buyer. (The number of copies that needs to be furnished shall be finalized by the Buyer and the Builder at the time of signing the Ship Building Contract)

The builder shall also prepare data booklets for Hull, Machinery and electric equipment giving the name/address of makers and references to such information as maintenance instruction books and/or spare parts list.

Spare part booklet for main engine & other equipment shall be submitted at the time of delivery along with the delivery documents.

L EQUIPMENT AND SPARES

Spare parts shall be supplied by the Builder according to the OEM Specifications, which are mandated by Classification Society and Regulatory Authority for the intended operation.

The list of inventories that needs to be supplied along with the ship shall be as finalized between the Buyer and the Builder.



MAIN GROUP 1

SHIP GENERAL



SHIP GENERAL

10 SPECIFICATION, GEN. DESIGN, etc.

Measurements, calculations, etc. shall be in accordance with metric or decimal systems.

SI unit system shall be generally used throughout the vessel for drawings, scales etc.

The Builder is entitled to apply the following standards:

Standards issued by International Organisation for Standardization (ISO)/Norsk Standard(NS), Japanese Standards Association (JIS)/German Institute for Standardization (DIN) /BIS (Bureau of Indian Standards) or other renowned standards.

International Electrotechnical Commission (IEC) Publication No.60092 - "Electrical Installations in Ships"

101 MODEL TESTING & ANALYSIS

Model test may be conducted if deemed necessary by Buyer.

The model test, if required, shall be performed in a reputed and recognized model testing facility conforming to ITTC standards of tank testing and extrapolation. The test shall be conducted in the presence of Buyer's authorised representative for confirming the propulsive power, speed, bollard pull, etc. The scope of model test shall be finalized by the Buyer and the Builder. The test shall include the following:

- a. Resistance test at designed draught
- b. Self-Propulsion test at designed draught
- c. Propeller open water test for designed propeller
- d. Bollard pull test at designed draught

15 QUALITY CONTROL, INSPECTION, TESTS & TRIALS

All hull structure, machinery, electrical equipment and outfit shall be inspected and approved by the Buyer or their authorized representative according to normal shipbuilding practice during the construction of the vessel. The completed vessel with all machinery, outfit and equipment shall be tested by the Builder to demonstrate their efficient working and to confirm that all requirements of the specifications and plans are fully complied with.

The Buyer shall be intimated in advance on the dates of all major tests and trials including Sea Trials, FAT of major equipment, Inclining Experiment etc.

151 MACHINERY TESTING

All tests and trials shall be carried out in accordance with OEM recommendations, Class & authorities' requirements and as per Builder's standard practices. OEM recommended test & trial protocols shall be approved by Buyer, and Class wherever applicable.



Dock Trial

Builder shall demonstrate the complete workability and correct functioning of the vessel, Propulsion systems, auxiliaries, generators, systems, equipment, etc. and notify/issue trial schedule to the Buyer. These dock trials shall be conducted in presence of representatives of Class, Buyer's representative(s) and other Regulatory Authorities wherever applicable.

152 INCLINING EXPERIMENT

The inclining experiment shall be conducted when the vessel is as nearly complete as possible, under the supervision of Classification Society, Regulatory Authority and the Buyer, to ascertain the lightship weight and vertical centre of gravity as per classification society requirements.

The inclining experiment report shall be submitted to the Buyer and Classification Society, showing calculation of metacentric height and other related characteristics as required.

Final Stability Booklet, incorporating the results of inclining experiment shall be submitted for approval to the Classification Society and Regulatory Authority.

In case of series vessels, inclining experiment shall be conducted on first vessel of the series only. For other vessels, lightship assessment shall be conducted as per Classification Society guidelines for completing the stability booklet.

154 SEA TRIALS

Sea trial shall be carried out when the vessel is substantially completed. Auxiliary machinery, deck machinery, life-saving equipment, electric system, communication system, piping system, etc. are tested, as to confirm their operation. All trials to be carried out as per Class Guidelines, OEM recommendations and Builder's standards/practices. The trial protocol shall be approved by Class and Buyer.

- Speed trials are to be carried out at 50%, 75%, 90% and 100% RPM of the thruster at design draught of the vessel. The vessel's speed shall be measured by means of electronic measurement system (DGPS) for one double run. One double run shall consist of one (1) run in a direction on the course and one (1) run in the opposite direction.
- The following manoeuvring tests shall be performed.
 - i. Turning Circle Test
 - ii. Zig-Zag Tests
 - iii. Crash Stop Test-Ahead
 - iv. Crash Stop Test -Astern
- Endurance trial is to be carried out at 100% RPM of the thrusters with both DG and Battery supplying power to the motor. Throughout the period, readings of pressures



and temperatures are to be recorded as per Diesel generator & thruster manufacturers' recommendation. Fuel oil consumption for diesel generators and Soc of batteries to be recorded during endurance trial. Duration of endurance trial shall be determined by the time taken for depletion of battery Soc from Maximum Soc to Minimum Soc as suggested by the Battery Manufacturer.

- Steering gear trials are to be carried out, as per Classification Society requirements. The time taken to move the thruster and the thruster angle is to be recorded.
- Anchor trials are to be carried out in accordance with Classification Society requirements.
- Bollard Pull test: Bollard pull of the vessel has to be assessed during performance trials. During the bollard pull trials, adequate propeller immersion is to be ensured. The depth of water below keel is not to be less than 2 times the maximum draught of the vessel. Length of the tow ropes, measured between the stern of the vessel and the test bollard, shall be at least two times the length of the vessel. Bollard pull shall be measured by a calibrated Load cell. The test shall be carried out for a duration of 15 mins with vessel in a stable position, heading & line fluctuations are constant. During the time towline force, power and thruster speed shall be recorded. The highest consecutive 5 minute period shall be considered for determining the bollard pull using arithmetic average during the period. The vessel is required to demonstrate bollard pull for the below operational configuration in the ahead condition with vessel loaded to design draught.
 - i. Battery Only - Should meet bollard pull requirement as per the port tender requirements.
 - ii. Diesel Generator Only-Achieved bollard pull shall be noted and included in the bollard pull certificate

16 GUARANTEE

The vessel shall be guaranteed for a minimum period of twelve (12) months after the official delivery date. This guarantee shall include all workmanship, material, machinery, equipment, outfitting, painting and other items.

However, damages resulting from mishandling of equipment or installation, or operation contrary to the instruction of the maker are excluded from the scope of this guarantee.



MAIN GROUP 2

HULL



HULL

20 HULL MATERIALS, GENERAL HULL WORK etc.

201 HULL MATERIALS

Structural Steel

The main hull shall be all welded steel construction conforming to classification society rules. The steel for hull construction shall be in general of Grade A. High tensile steel may be used as appropriate, as per the design & class approved drawings.

The materials used shall be of good international shipbuilding standards. Steel plates, forgings and castings shall be delivered with certificate according to the Classification Societies and Regulatory Authorities' requirements. Test marks and makers name shall be clearly stamped there on.

204 TESTING OF TANKS, BULKHEADS

Air pressure tests shall be done for all tanks as required by Classification rules.

Hose testing of doors, hatches and other shell side and deck openings shall be done according to Classification Society requirements. Hose testing shall be carried out on all watertight structures, which are not tested by water or air pressure.

Structural Testing

Structural testing (hydro-test) for tanks (except voids) shall be done as per class requirements.

The tests shall be performed in the presence of Class Surveyor and Buyer's Representative. Also, the Buyer shall be intimated about the test schedule in advance.

Test reports shall be submitted to the Buyer.

205 NON-DESTRUCTIVE TESTING (NDT)

NDT shall be carried out as per Class requirements.

X-ray testing shall be carried out as per Classification Society requirements and class approved NDT Plan.

Ultrasonic or dye-penetration test of weld shall be carried out to the satisfaction of Classification Society where it is not possible to undertake X-ray testing.

207 WELDING

Welding shall be carried out in accordance with the requirements of classification society.



Welding of hull and all main structural elements shall be carried out only by welders qualified through standard welding procedures approved by Class.

21 AFTBODY

The thickness of the shell plating shall be in accordance with class requirements. Increased thickness may be considered if required i.w.o. thruster units, based on structural analysis and recommendations from supplier, if any.

A double plate skeg of adequate size shall be fitted on the centre line. Skeg depth shall be finalized based on the navigational draught restrictions and dimensions of the selected thruster.

22 MIDSHIP AREA

226 BULKHEADS AND TANKS BELOW MAIN DECK

Bulkheads

Bulkheads shall be suitably stiffened in accordance with Class requirements.

Hull Tanks

Hull integrated tanks shall be arranged according to the general arrangement drawing.

Separate Service/Day tanks shall be provided for DG. The capacity of the day tanks shall be decided as per class/statutory requirement.

23 CARGO AREA

Deck loading in the aft working deck shall be as per class rules or as agreed between the builder and the buyer

The vessel shall have a working deck area of at least 65 m².

24 FOREBODY

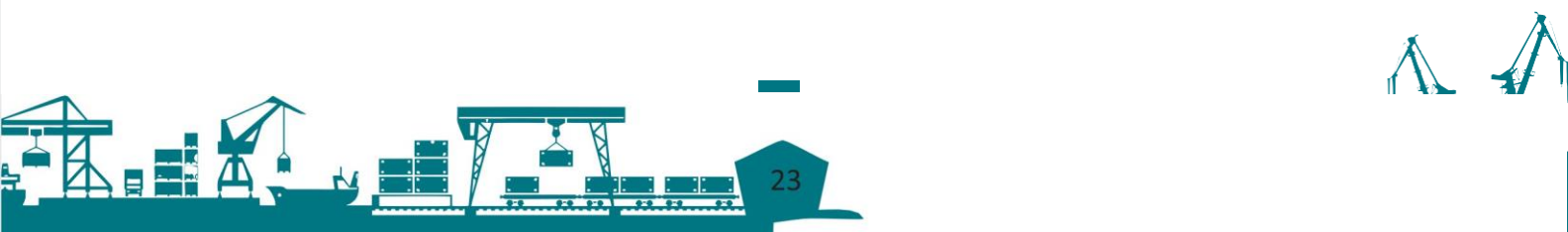
General plating thickness to be as per class rule requirements.

Collision bulkhead shall be provided in accordance with class rules.

247 CHAIN LOCKERS

Chain locker for anchor chain cable shall be provided. The size of chain lockers shall be sufficient to accommodate full length of the chain.

25 DECKHOUSE AND SUPERSTRUCTURE



251 SUPERSTRUCTURE

The structural scantling shall be in accordance with class requirements.

253 MAST

A steel mast for navigation lights and antennae shall be fitted at the suitable location on the wheelhouse top deck at centreline.

Mast height and mast fittings including Navigation lights, signal flag yard, radar, antennae etc. shall be determined in accordance with relevant Class/Statutory Rules.

Adequate stays shall be fitted, if necessary, to reduce vibration.

The hull structure under the mast shall be stiffened suitably.

Masts to have rungs carried on top, arranged for access to light trays and necessary fittings. Safety cage shall be fitted if necessary.

254 BRIDGE

The wheelhouse shall be designed and built with as near as possible 360° unobstructed visibility.

Bridge shall be provided with clear, wide and large size windows wherein each bridge window shall be fitted with a pull down/roll up sun screen shade and wipers. Suitable arrangement shall be provided for washing wheelhouse front windows.

Tinted sky windows shall be installed slantwise in the wheelhouse top deck, fitted in metal frames.

26 HULLOUTFITTING

261 HULL MARKINGS

All markings shall be as per best global standards.

The ship's name shall be marked with suitable materials and mounted on the superstructure port and starboard (P&S).

Other hull markings like Port of Registry, IMO number, Owner's logo etc. shall be provided at appropriate locations, as agreed between the Builder and the Buyer, as per global best shipbuilding practice.

Draught marks shall be marked using weld beads/steel plates and shall be painted in white on bow and stern on P&S sides. Horizontal marks at every 100mm distance, metrical scale shall be followed.

The vertical extent of the draught marks shall be adequate to cover the draught of the vessel



under all probable conditions of loading and corresponding trims with the vessel undamaged.

All machinery equipment, valves, hand wheels, levers, doors, ventilation etc. shall be indicated by name plates of plastic/suitable non corrosive metal with black letters in English.

Bottom plugs and manhole covers shall be marked with tank number and content using weld beads.

Water tight bulkheads, tank boundaries, number and contents shall be marked on hull and deck.

Loaded waterline shall be marked using appropriate paint as per global best shipbuilding practice.

262 BOTTOM PLUGS, BILGE WELLS ETC.

One (1) bottom plug each shall be supplied and fitted in hull tank, cofferdam, etc. where considered necessary.

The size and design shall be as per global best shipbuilding practices.

Water tanks shall have square and oil tanks shall have hexagonal sockets respectively.

Special attention shall be given to locate the bottom plugs as close as possible to the lowest point of each tank. The bottom plugs shall be kept clear of points designated for keel blocks as per docking plan.

Bilge wells and sea tubes shall be arranged as necessary at suitable places in the double bottom.

263 FOUNDATIONS

All auxiliary, deck machinery, electrical equipment etc. shall be erected on foundations.

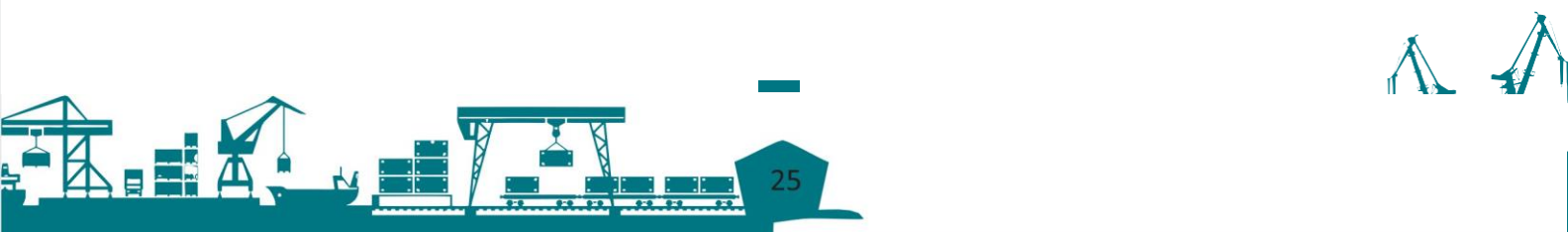
As far as practicable, all deck machinery foundation shall be open type with accessibility for cleaning and painting works. Suitable reinforcements and insert plating shall be provided under the machinery, wherever necessary. Proper draining arrangement shall be provided to avoid accumulation of water.

264 FENDER, BILGE KEEL

| | |
|-----------------------|------------------------------|
| Fender Bow | -Cylindrical Fender& Wfender |
| Stern | -Cylindrical Fender |
| All around the vessel | -Dfender |

Tyre fenders are to be fitted around the vessel

The final arrangement including the selection of fender types and size shall be decided based on Buyer's preference and design requirement on fender type and fender pressure.



Bilge Keel

Bilge keels shall be provided on the vessel.

Welding of bilge keel shall be performed as per Class approved design drawings. Preferably, notch welding shall be applied two bilge keels and the bilge keel has to be welded on doubler plate against shell plating.

266 HAWSE PIPES

The hawse pipe with anchor pocket shall be fitted in such a way that free anchor fall is obtained. The anchor pocket shall be designed for accommodating stockless anchors

The hawse pipe shall have adequate diameter and length to easily house the anchor shank and shackle.

Chafing ring of steel bar shall be fitted at the lower edge of chain pipe for protection and smooth running of chains.

267 BULWARKS

Strong bulwarks of steel plate, suitably stiffened shall be fitted all round the vessel at main deck and forecastle deck.

The bulwark shall have tumble home and access doors shall be provided on both port and starboard side in the main deck level. Additionally, access may be provided on forecastle level for pilot boarding

The top of the bulwark shall be reinforced with a flat bar/steel pipe of suitable dimension/thickness.

27 MATERIAL PROTECTION

271 PAINT SPECIFICATION

The paint system shall be of good quality marine grade. The final paint specification shall be mutually agreed between Builder and Buyer, as per the recommendations from the paint maker.

Final colour and decals to be confirmed by Buyer.

Paint in underwater hull, water ballast tanks, fresh water tanks, to be guaranteed for five (5) years. All dry film thicknesses shall be as recommended by supplier for a five (5) year system.

Paint specification and surface preparation shall be of high standard, wherein prior to fabrication, all steel work shall be shot-blasted to SA 2.5 and shop-primed. The surface preparation and paint specification shall be in compliance with SOLAS with respect to toxic and environmental requirements. Surface treatment shall be given to all welds, sharp edges, undercuts, slag, etc.



Decks to be coated with high friction anti-skid paints, in alignment with the paint scheme.

All edges, corners, logs, weld seams etc. to be stripe coated with brush or roller, between each layer according to paint maker's instructions.

Descaling, shop priming, de-rusting and painting works shall be carried out in accordance with the paint maker's recommendation and yard practice.

In general, if in-water time before delivery exceeds 180 days (number of days shall be mutually decided between the Buyer and the Builder), a diver inspection shall be carried out and attended by a qualified paint maker.

All necessary remedial works as per the recommendations of the paint maker shall be carried out based on the observations during such inspections, including re-docking if necessary.

Paint Scheme

Painting scheme in general shall be as given below. Detailed paint scheme covering all areas of the vessel shall be prepared in consultation with paint manufacturer for a 5-year system.

| Underwater Hull | 2 coats of tar free epoxy 1 coat of sealer 2 coats of tin free anti-fouling | DFT as per paint maker recommendation for 5-year life |
|--|---|---|
| Topsides | 3 coats of Re-coatable epoxy | DFT as per paint maker recommendation for 5-year life |
| Inside machinery spaces/ Accommodation/ Thruster Room/stores etc. | 2 coats of alkyd paints/as agreed between builder and buyer | DFT as per paint maker recommendation |
| Ballast Water& FWTanks | As per paint maker recommendation for 5-year life | As per paint maker recommendation for 5-year life |
| Main deck/Raised Main Deck | As agreed between builder and buyer | As per paint maker recommendation |
| Super structure | As agreed between builder and buyer | As per paint maker recommendation |
| Funnel | As agreed between builder and buyer | As per paint maker recommendation |
| Void spaces | As agreed between builder and buyer | As per paint maker recommendation |



278 EXTERNAL CATHODIC PROTECTION

Sacrificial Anodes

Ship's external hull shall have cathodic protection against corrosion for 5 years.

MGPS/ICAF System for Sea Chests/Box Coolers

Marine Growth Prevention System (MGPS)/Impressed Current Anti-Fouling System (ICAF) may be installed for sea chests (designed for 5-year life), based on Buyer's requirement



MAIN GROUP 3

MISCELLANEOUS EQUIPMENT



MISCELLANEOUS EQUIPMENT

30 SMALL HATCHES & MANHOLES

Manholes

Bolted manholes shall be provided, in number and location as necessary, as per class requirement for access to all compartments, tanks, cofferdams, voids and pockets not provided with other means of access.

Hatches

Hatches shall have steel covers.

Single wheel/lever and multiple clip action type weather-tight access hatches shall be provided on weather deck.

For the removal of main machinery during overhaul/ maintenance, flush type bolted hatches are to be installed on the main deck atop Machinery room.

33 DECK CRANES FOR CARGO (Optional)

| | |
|-------------------|--|
| Type | - Knuckle boom |
| Safe working load | - min 1.5T at 8m working radius. |
| Power | - Dedicated electro-hydraulic power pack as per makers' standard |

Requisite calculations, as mandated by the class for ensuring the stability of the vessels shall be performed and demonstrated by the Builder to the Class.

Note: The rescue boat launching crane if provided can be utilized as deck cargo crane provided both the specification as stipulated in this specification is met and acceptable to statutory body(ies) & class.



MAIN GROUP 4

SHIP EQUIPMENT



SHIP EQUIPMENT

41 NAVIGATION EQUIPMENT

Navigation equipment is to comply with the requirements specified in the Rules & Regulations in Para O.F as applicable at the time of vessel construction. Any additional equipment as required by buyer shall also be considered if any.

42 COMMUNICATION EQUIPMENT

External Communication equipment is to comply with the requirements specified in the Rules & Regulations in Para O.F as applicable at the time of vessel construction. Any additional equipment as required by buyer shall also be considered if any.

425 CALLING, COMMAND AND TELEPHONE SYSTEM

Internal communication equipment list:

- | | |
|--------------------------|-------------------------|
| a. Auto telephone system | b. Talk back system |
| c. Public address system | d. General alarm system |

Separate systems shall be provided for talk-back and loudhailer systems.

Telephone System/PA System

Telephones shall be provided in Wheel house, MSB room, Cabins etc. Number of telephones and their locations to be finalized during contract stage.

Loudspeakers for PA function shall be mounted in public area such as corridors, mess/cabins, etc

Public Address & General Alarm System can be integrated system.

427 LIGHT AND SIGNAL EQUIPMENT

Light & Signal equipment shall comply with the requirements specified in the rules & regulations in Para O.F.

43 ANCHORING, MOORING & TOWING EQUIPMENT

General

Anchoring, mooring equipment and towing arrangement shall be provided as per Classification Society requirements.

431 ANCHORS WITH CHAIN & EQUIPMENT

Anchor and Chain Cable

- | | |
|--------------------|---|
| Anchors and chains | - Two HHP stockless type anchors in pockets |
| | - Grade 2, stud link |
| Windlass | - Arranged in the forecastle |



- Anchor windlass shall be combined with forward towing winch
- For details, ref. SFI No. 435

434 MOORING EQUIPMENT

Mooring Capstan

Mooring equipment shall be provided as per class requirement.

Mooring rope, towing rope, heaving lines, hawser lines as per applicable class rules shall be provided.

One (1) off Electric/hydraulic Mooring capstan shall be provided with 5 tonne line pull & controls near the capstan.

Bollards & bitts shall be as shown in General Arrangement. Arrangement of mooring equipment to be finalized during contract stage

435 TOWING EQUIPMENT

Forward Towing System

The towing system shall be equipped for ship assist operation with winch and staple. In general, towing system shall have a load rating as per the buyer's requirement.

Towing system to have a load rating of 60 tonnes.

| | |
|-----------------------------|---|
| Winch Type | -Anchor Towing Winch |
| Drive type | - Electro-hydraulic |
| Drum configuration | -Single drum |
| Towline force (first layer) | - as per OEM recommendations |
| Brake holding load | - minimum 150 tonnes at 1st layer of drum |
| Safety features | - emergency quick release and other safety features in accordance with Class requirements |

Hauling speed of anchor shall be at least 10 m/min.

Forward staple shall be provided and rated for bollard pull of the vessel.

Controls shall be provided both locally and from wheelhouse.

Winch shall be capable of using synthetic rope if required as per buyer's requirement.

==OPTION START==

Aft Towing Hook (OPTIONAL)

Towing Hook with quick releasing system, which can be operated from the wheelhouse and from the main deck near the hook, may be provided for aft towing based on the Buyers' requirement.

Safe working load min. 60T



Sufficient rope guiding arrangements such as tow pin/gob eye may be provided on the aft deck, based on requirement from the Buyer.

Aft Towing Winch (Optional)

A towing winch shall be installed at the aft complete with drum, brakes, clutch etc. In general, towing system to have a load rating per the buyer requirement.

Aft towing system to have load rating of 60 tonnes.

| | |
|-------------------------|---|
| Winch Type | -Aft Towing Winch |
| Drive type | - Electro-hydraulic |
| Drum configuration | -Single drum |
| Towline force | - as per OEM Recommendations |
| Brake holding load | - minimum 150 tonnes at 1st layer of drum |
| Safety features | - emergency quick release and other safety features in accordance with Class requirements |
| Hauling speed of anchor | -As per class requirement |

Aft staple shall be provided and rated for bollard pull of the vessel.

Controls shall be provided both locally and from wheelhouse.

Winch shall be capable of using synthetic rope if required as per buyer's requirement.

==OPTION END==

438 HYDRAULIC OIL SYSTEM FOR ANCHORING/MOORING/TOWING EQUIPMENT

If Hydraulic winches are fitted, one set of electro-hydraulic power unit consisting of hydraulic oil pumps and other necessary accessories shall be provided. This hydraulic power unit drives the towing and mooring equipment shall be provided as applicable. Hydraulic oil tanks of sufficient capacity shall be provided.

44 REPAIR/MAINTENANCE EQUIPMENT

Suitable lifting arrangements including lifting eyes shall be provided inside machinery spaces to enable removal of engine/DG Set parts and other auxiliaries.

48 OIL SPILL RESPONSE EQUIPMENT (OPTIONAL)

Oil Spill Dispersant Arm (OPTIONAL)

Oil Spill dispersant spraying arms may be installed on the main deck on both the sides.

Oil Spill Dispersant storage tank(s) with a total capacity of at least 5 m³ may be provided.

Oil Spill Containment Boom (OPTIONAL)

The vessel shall be capable of handling near shore booms of total length of 1000m, stowed on adequate number of boom reels as per the OEM standards.

Out of this, one boom reel shall be carried on the aft deck of the vessel as indicated in the GA. Additional reels may be carried on the aft main deck based on operational demands.



MAIN GROUP 5

SHIP EQUIPMENT FOR CREW



SHIP EQUIPMENT FOR CREW

50 LIFESAVING EQUIPMENT

Lifesaving equipment's like Rescue Boat, Life Rafts etc. shall be provided in compliance with the requirements specified in the rules & regulations in Para 0.F.

505 FIREFIGHTING EQUIPMENT

Firefighting equipment shall be provided on the vessel in compliance with the requirements specified in the rules & regulations in Para 0.F.

FRP cabinet shall be provided for securing fire hoses and nozzles.

FIFI 1 requirements of the selected class (Optional)

Sufficient number of fireman's outfit, breathing air compressor, etc. in compliance with FIFI 1 requirements of the selected class shall be provided on the vessel.

51 ACCOMMODATION-INSULATION, PANELS, DOORS, WINDOWS, LOCKERS

General

Class approved materials shall be used for the vessel as applicable, including fire retardant paints, curtains, linings, etc.

510 ACCOMMODATION

In general accommodation arrangement shall be provided as per the General Arrangement Plan. However, alternate arrangements may be adopted as agreed between the Buyer and the Builder.

The vessel shall be arranged with the following facilities in cabins:

Master/Chief Engineer Cabin

- Wooden berth with drawers
- Wooden Wardrobe with mirror
- Writing table with locker
- Upholstered arm chair
- One settee
- Document Locker/Shelf
- Coat hooks
- Flask & glass holder
- Book rack
- Wall mounted fans
- Attached Toilet

Other Cabins

- Wooden berth with drawers



Wooden Wardrobe with mirror
Writing table with locker
Arm chair
Coat hooks
Flask & glass holder
Book rack
Wall mounted fans
Attached Toilet (optional)

511 PARTITION BULKHEADS, PANELLING

In general, thickness of linings shall be 25 mm and that of partitions shall be 50 mm. The partitions shall be of non-combustible panels having good quality surface finish.

Low flame spread sandwich panels shall be provided for ceilings.

Ceiling and partition panels in galleys shall be provided with stainless steel cladding sheets.

512 DOORS

In general, accommodation spaces shall be fitted with joiner doors and fire rated doors as applicable.

Weather tight doors are to be provided for exterior access to wheelhouse and lower deckhouse.

Watertight doors shall be provided on the main watertight bulkheads. All watertight doors are to be fitted with hinges and toggles in compliance with class requirements.

The wheelhouse doors shall be hinged and provided with glasses for good visibility.

Sill height to be in accordance with the relevant Rules and Regulations.

515 WINDOWS

All accommodation areas shall be provided with windows/scuttles/skylights as per the requirements of Regulatory Authorities and Classification Societies.

All windows shall be made of toughened glass and fitted in metal frames.

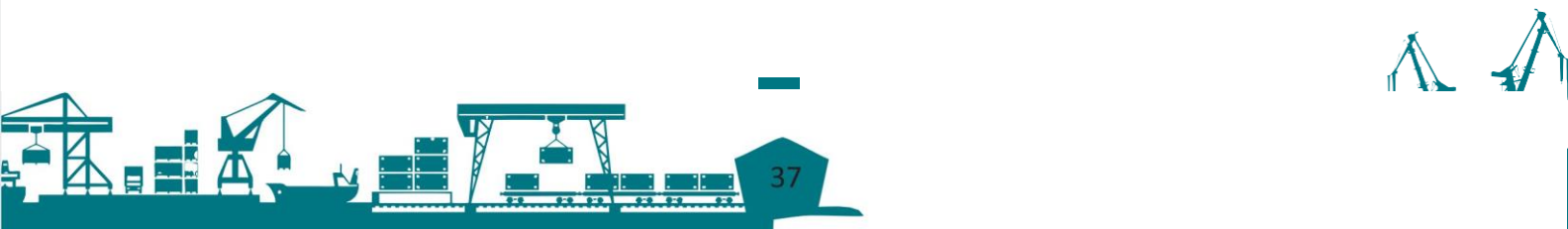
518 INSULATION

Insulation for fire, heat & sound shall be provided in accordance with class/statutory requirements, conforming to global best practices in tug construction.

52 DECK COVERING, LADDERS, STEPS, RAILINGS, GANGWAY ETC.

In general, floorings, ladders and other fittings shall be provided as described below:

- a. Flooring in cabins, public spaces, corridors, stairways etc. shall be provided with suitable deck composition and laid with vinyl covering.



- b. Flooring in engine control room, alleyways, mess room and wheelhouse shall be preferably of composite synthetic type.
- c. Sanitary spaces and galley shall be laid with non-slip type tiles over cement.
- d. Suitable flooring arrangement (Aluminium or Steel chequered floors) shall be provided in machinery spaces as agreed between the Builder and the Buyer.
- e. Ladders, stairs and handrails shall be provided as required.
- f. Steel handrails of suitable diameter shall be welded along the sides and front of the deckhouse.
- g. One (1) set of aluminium alloy gangway (optional) of 4m length, 600mm clear breadth may be provided. Dimensions of the gangway to be as agreed between the Buyer and the Builder.

54 WHEEL HOUSE

The wheelhouse shall be arranged with all necessary equipment as per the requirements specified in the rules & regulations in para 0.F. which includes but not limited to the below.

| | |
|---------------------|------------------|
| Consoles | Chart table |
| Flag locker | Binocular holder |
| Revolving Arm chair | GMDSS Table |

Special attention shall be given to the overall ergonomics while arranging wheelhouse items.

55 GALLEY/PANTRY EQUIPMENT, PROVISION PLANTS, LAUNDRY/IRONING EQUIPMENT

551 GALLEY

Galley shall be provided with the following equipment:

Electric marine range with oven
 Full size refrigerator with freezer
 Stainless steel side board
 Stainless Steel Sink
 Stainless steel worktable
 Canopy with electrically-driven exhaust fans

554 PROVISION STORE AND REFRIGERATION SYSTEMS

A provision store shall be provided in the main deck.

Deep freezers of adequate capacity shall be installed in provision store for carriage of meat, fish, vegetables, dairy products, etc.

558 LAUNDRY

One marine heavy duty washing machine cum dryer shall be provided on lower accommodation deck.

Separate washing machine and drier units may also be considered based on Buyers' preference.



57 VENTILATION, AIR CONDITIONING & HEATING SYSTEMS

General

The AC plant and system should be designed for the following parameters: -

| | |
|----------------------|--|
| External Temperature | Maximum 41° C Dry Bulb (DB), Minimum 10° C Dry Bulb (DB). |
| Internal Temperature | All air-conditioned compartments (except Galley) is to be 24°C Effective (27° C DB/20° C WB, Relative humidity 40 to 60%) Galley is to be 29° C Effective (35°C DB/26° C WB). |

Design temperatures may be modified suitably based on area of operation & buyers' requirement.

571 VENTILATION/AIR-CONDITIONING SYSTEMS FOR ACCOMMODATION, CONTROL SPACES ETC.

Entire accommodation area, wheelhouse and switch board room shall be air conditioned.

Standalone centralized unit (direct expansion) shall be considered for accommodation. Water cooled independent A/C shall be provided in MSB room and air-cooled split A/C to be provided Wheel House.

Other options such as chilled water system with fan-coil and fresh air handlers etc. may be considered as agreed between the Builder and the Buyer.

574 VENTILATION/AIR-CONDITIONING SYSTEM FOR MACHINERY SPACE

The machinery space shall be ventilated by a mechanical ventilating system.

The ventilating fans shall supply fresh air to the operating station and other necessary places in the engine room through air ducts. One off supply fan in engine room shall be of reversible type.

The exhaust air from the engine room shall be led to the atmosphere through openings provided on the funnel.

The exhaust air opening and fresh air intakes for engine room shall be provided with emergency shut-off fire dampers operated from the outside of the engine room.

Mechanical ventilation shall be provided for service/machinery spaces including thruster room, CO2 room, workshop etc.

Battery room ventilation arrangement shall be independent of other ventilation systems or as applicable by the class rules.

In addition, galleys and toilets shall also be provided with suitable arrangements for forced ventilation.

Battery room shall be Air conditioned to maintain temperature as per manufacturer recommendation.



58 DRINKING AND SANITARY SERVICE SYSTEM FOR ACCOMMODATION

581 SANITARY SUPPLY SYSTEM

Fresh Water Service System

The system shall supply fresh water for sanitary services in accommodation, equipment in machinery spaces, galley and laundry.

- FW Pressure set
- Primary and standby electrically driven pumps
 - Diaphragm type hydrophore

Fresh Water Calorifier

Hot water requirements for accommodation and other consumers, if required, shall be supplied from one (1) electrical hot water calorifier. One (1) electric circulating pump shall be fitted at the return line of the calorifier, capable of circulating hot water at 65 deg C.

Sea Water Service System

Separate sea water system shall be provided for toilet flushing.

- SW Pressure set
- Primary and standby electrically driven pumps
 - Diaphragm type hydrophore

Alternate system for sanitary supply may be considered based on Buyer's preference.

582 SANITARY DISCHARGE SYSTEM

In general, sanitary discharge system shall consist of sewage treatment plant, sewage holding tank and shore discharge pump.

Sewage treatment plant shall be considered as mentioned in Para. 585.

Shore Discharge flange to conform to MARPOL 73/78, Annexure 4, Regulation 10.

583 SHOWERS AND TOILETS

Toilets shall have gravity type discharge.

Alternate arrangement for toilets shall be considered based on Buyer's preference.

584 DRINKING WATER SYSTEM

Fresh water system for drinking shall be provided as per Para 581, Fresh Water Service System.

The drinking water system shall consist of filter, UV Sterilizer and Coolers.

585 SEWAGE TREATMENT PLANT (STP)

One (01) off sewage treatment plant meeting the statutory regulations with adequate capacity shall be provided.

In general, STP shall be of electrolytic type. Other types may also be considered based on Buyer's preference.



MAIN GROUP 6

MACHINERY MAIN COMPONENTS



MACHINERY MAIN COMPONENTS

General

Propulsion system shall consist of 2 Nos of azimuth stern thrusters each driven by independent electric motors.

Equipment

2 x electric Motors, as per section 625

2 x azimuth stern thruster units, as per section 634

62 OTHER TYPES OF PROPULSION MACHINERY

625 PERMANENT MAGNET PROPULSION MOTORS

Two numbers of permanent magnet motor shall be provided. Operating voltage shall be suitably selected based on the system voltage. The system shall be water cooled. All motor data is subject to tolerance in accordance with IEC. The motor RPM to be selected to suite the L-Drive requirement.

The Standards to be followed as below:

| | |
|------------------|-------------------|
| Standard | : IECorequivalent |
| Insulation Class | : min Class H |
| Temp rise | : min Class F |
| IP Rating | : min IP44 |
| Duty cycle | : Continuous Duty |

The safety parameters of propulsion motors shall be provided as recommended by OEM and rules.\

| | |
|----------|-----------------------------------|
| Quantity | : 2No. |
| Capacity | : about. 1800 Kw. |
| Speed | : As required by propulsion Unit. |

63 THRUSTERSANDTRANSMISSIONS

634 PROPULSION UNIT

Two numbers fixed pitch steerable rudder propeller units shall be provided:

| | |
|--------------------|---------------------|
| Rated input power | As required for 60T |
| Rated RPM | To suite L-Drive. |
| Propeller Diameter | - abt. 2600mm |

Thruster shall be designed to deliver adequate power so as to meet the intended operations as per Ch. 0, para-E.



Emergency steering of the vessel shall be as per statutory/class rules. Steering system shall comply with the class requirements.

Steering system can be hydraulic/electric system.

If steering system is hydraulic, then hydraulic unit for thruster units shall be as per maker's standard. The units along with hydraulic oil tanks of sufficient capacity shall be provided in thruster room.

637 MAIN REDUCTION GEAR

Gearbox having appropriate gear ratio shall be integrated with the thruster unit, as per thruster OEM design.

65 GENERATOR SET FOR MAIN ELECTRIC POWER

At least 2 Nos. Diesel generators as per section 861 shall be provided. Final rating shall be as per electrical load calculation carried out during the contract stage. DGs shall be resiliently mounted if required, to reduce vibration.

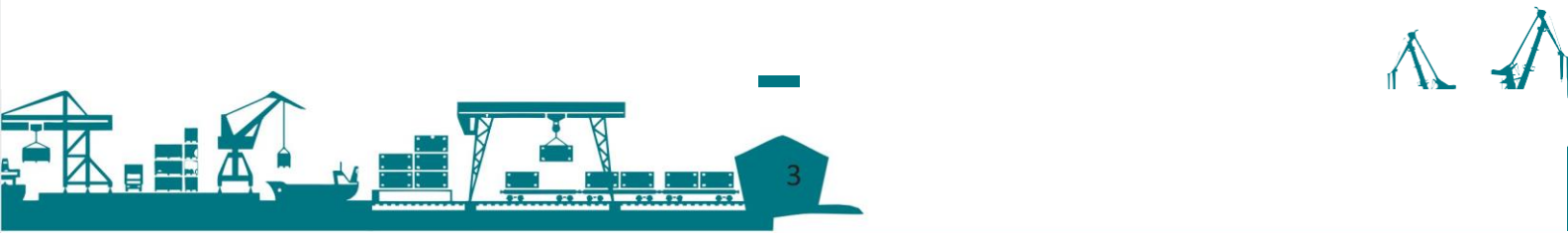
| | |
|--------------------------|-----------------------------|
| 2 Nos. Diesel generators | |
| Total Installed Capacity | : Min. 1600 kW |
| Voltage | : 690 V, 50Hz, 3 Ph, 0.8 pf |

66 OTHER AGGREGATES FOR MAIN AND EMERGENCY ELECTRIC POWER

664 RECTIFIER CUM BATTERY CHARGER

Emergency source of electrical power is an accumulator 24V battery.

One (1) off rectifier cum battery charger of appropriate rating shall be installed. During normal condition it will be used for both charging batteries and feeding power supply to emergency consumer. Upon failure of main source of electric power, accumulator battery shall feed power supply to emergency consumers through emergency switchboard.



GROUP 7

SYSTEMS FOR MACHINERY MAIN COMPONENTS



SYSTEMS FOR MACHINERY MAIN COMPONENTS

General

All machinery systems and components shall be of good marine quality as per international standards and arranged according to class requirements and/or OEM recommendations.

Piping- General

Piping shall be designed as per best global standards and classification guidelines.

Piping shall be adequately supported.

Routing of pipes shall be done in such a way that it permits free passage in walking areas, does not affect the performance of the crew. Special attention shall be taken to provide space for maintenance of ship's structure as far as practicable.

Piping Material Specification

Material for the piping, valves, flanges and fasteners for piping and other system related material shall be selected as per relevant class requirements.

Treatment of these pipes shall be done in accordance with the relevant class requirements.

In general, the materials for various systems shall be as follows:

- Bilge & Ballast - Galvanized Steel
- Sea Water - Galvanized Steel
- Fresh Water System - Copper or class approved plastic
- Exhaust - Tail pipes above funnel shall be of polished Stainless Steel material. Mild steel to be used elsewhere.
- Fuel Oil System - MS Black Steel
- Lube oil system - MS Black Steel

70 FUEL SYSTEM

The fuel oil system shall consist of Fuel Oil Service System and Fuel Oil Transfer System.

Suitable bunkering arrangements as agreed between the Buyer and the Builder shall be provided on the main deck, with suitable connections for filling of the bunker tanks. Class approved sampling system shall be provided at the bunkering station.

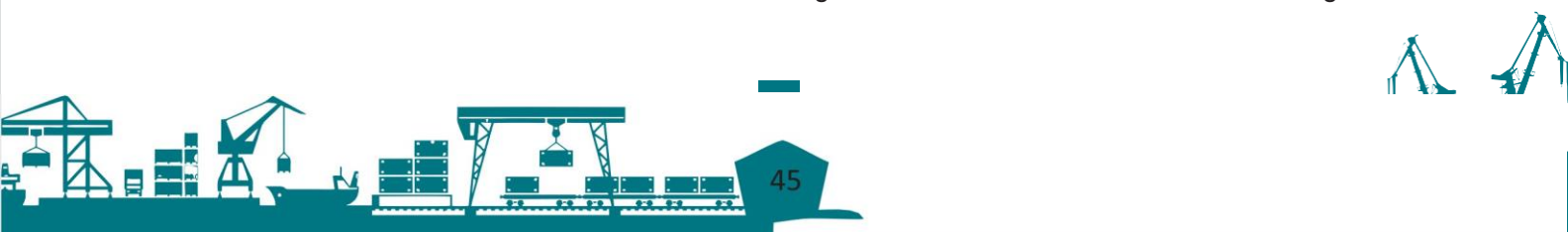
Flow monitoring system shall be provided for the Diesel Generators.

701 FUEL OIL TRANSFER AND DRAIN SYSTEM

Storage tanks, service tanks, overflow tank and sludge tank shall be provided.

FO Transfer Pump

Fuel oil shall be transferred from fuel oil storage tank to each fuel oil service tank using two



(one working and one standby) electrically driven transfer pumps, installed in the DG room.

702 FUELOILPURIFIERS/FILTERS

One no. fuel oil purifier/Filter rated at full power DG fuel consumption shall be provided in accordance with the OEM recommendation.

703 FUEL OIL SERVICE SYSTEM

Fuel Oil Service System

Fuel oil shall be transferred from fuel oil storage tank through F.O. purifier/Filter (as applicable) to each fuel service tank. From the service tanks, overflow lines shall be led to FO Overflow tanks.

Fuel oil shall be transferred from service tanks to diesel generators with the help of integrated fuel oil service pumps.

71 LUBE OIL SYSTEM

Self-contained lubricating oil systems shall be installed for the DG's, gears and drives. The lube oil system shall be as per OEM recommendations of main and auxiliary machinery.

Closed circuit lubricating oil system engine driven pump shall be provided with standby electric motor driven pump. Automatic changeover to be provided for Lube oil standby pumps with Engine driven pumps with suitable alarm.

Dirty oil in the sludge tank shall be discharged by means of the dirty oil/ sludge pump or via direct suction from the shore. The tank shall be provided with a high-level alarm.

Suitable number of lube oil tanks shall be provided by the Builder as hull tanks/loose tanks at appropriate locations based on the recommendations of OEMs of major machinery.

711 LUBE OIL TRANSFER & DRAIN SYSTEMS

LO Transfer Pump

One off Lube oil transfer pumps conforming to class and OEM requirements shall be provided for DGs.

A separate rotary hand driven LO transfer pump shall be provided for Dgs.

713 LUBE OIL SYSTEMS FOR TRANSMISSIONS

The gearbox lube oil system, if required, shall be as per OEM recommendations and complying to class requirements.



72 COOLING SYSTEM

Cooling system shall be provided for each propulsion machinery, D.G. sets, auxiliary machinery, HVAC and hydraulics. In general, the propulsion and auxiliary equipment cooling system are to be based on shell and tube/plate heat exchanger. Any other type of cooling system including box coolers shall be specially considered based on Buyer's requirement.

In case box coolers are fitted, the sizing of Box coolers shall be finalized by the builder based on the requirements of engine and other machineries.

A fouling factor of 15% is to be considered for plate/tube type heat exchangers and in case of box coolers fouling factor shall be 30%.

73 COMPRESSED AIR SYSTEM

A compressed air system of 8 bar pressure and having sufficient capacity shall be provided for the purpose of ship service air requirements. Air receivers of sufficient capacity shall be provided.

Service lines shall be provided for sea chest blow down, controls, and various equipment. A main deck service line shall also be provided.

74 EXHAUST SYSTEMS

The exhaust gas system for each generator shall contain the following equipment:

- Exhaust silencer (approx. 35 dBA and 125 Hz-for Diesel Generators)
- Integral exhaust gas spark arrestor

The exhaust system shall be designed such that it provides maximum isolation of machinery vibration and exhaust noise. Removable blanket type insulations are provided for the exhaust gas lines. The entire system shall be resiliently mounted, if required.

79 AUTOMATION SYSTEMS FOR MACHINERY

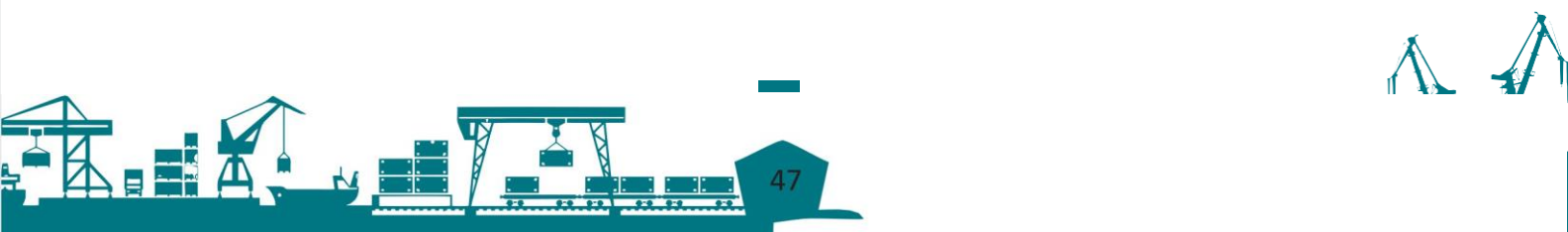
Vessel central control station shall be located in the wheelhouse. Monitoring screen shall be provided in the switchboard room and wheelhouse to select the functionalities or requirements to be monitored.

The PMS/EMS system along with BMS should be able to keep the battery operation smoother and within the designed DoD.

Alarms should be given to the switchboard/Wheelhouse on reduction in the SoC of the battery

As the battery approaches low Soc level there shall be provision to change from Battery to Hybrid mode in case the operator requires to have long endurance for the Tug.

The system shall be designed such that the DG's can also be used to charge the batteries



based on the load on the vessel.

The SoC level alarms can be set according to the operating profile requirements as per design.

VESSEL MONITORING SYSTEM

This system shall be independent of all automation & control systems onboard the vessel. This system will be used to collect all the vessel operational parameters for monitoring the vessel performance and operations. This system shall interface with the following equipment but not limited to:

1. GPS-Position & Time details
2. Speed Log-speed parameter
3. Battery Management System - Discharge power, State of Charge for the batteries
4. Diesel Generator-Running Status, power, Fuel consumption details
5. Propulsion System-power

Above parameters can be obtained from individual equipment or integrated automation systems existing onboard the vessel. All the parameters need to be recorded with common time stamp preferably the GPS time for analysis. The system shall be capable of storing at least one month's data. Also, the system shall transmit the data continuously to the offshore systems like cloud based system, port operation systems.

792 ALARM SYSTEM

Comprehensive alarm with monitoring system shall be provided as per class and OEM's requirement for major machinery including Battery systems, Propulsion systems, auxiliary engines, and critical ship systems etc. Temperature monitoring & alarm for battery room shall be provided as per class requirements.

793 PROPULSION CONTROLS

Remote operation shall be so designed that the propulsion plant can be operated from the wheelhouse. Instrumentation/alarms shall be as per class rules/maker standard.

Emergency control shall be provided, with which the propulsion motors can be controlled locally (switchboard room) in case the remote-control system failure.

UPS/24V power supply shall be provided for Automation System.

795 DIESEL GENERATOR CONTROLS

The generator engine shall be speed controlled remotely by governor control switch on main switchboard and controlled at engine side. Instrumentation/alarms as per class rules and OEM standards shall be provided.

Control power supply for the DGs shall be taken from 24V power supply provided onboard.

Local engine control panel with necessary alarms, indication lamps and control switches shall be provided.



MAIN GROUP 8

SHIP COMMON SYSTEMS



SHIP COMMON SYSTEMS

80 BALLAST, BILGE & DRAIN SYSTEMS

801 BALLAST SYSTEM

Ballast is not considered in the standard design. However, if required, the same may be included adhering to relevant statutory/class requirements.

803 BILGE SYSTEM

The bilge system shall comprise of One (1) Bilge pump and One (1) Bilge/GS/Fire, both of capacity as per the requirements specified in the rules & regulations in para 0.F. The pumps shall be vertical centrifugal electric driven type. One (1) oily water tank of sufficient capacity shall be provided.

Bilge main system shall be complete with suction from all watertight compartments. Engine room shall be provided with two nos. direct bilge suctions. Bilge alarms shall be installed in each watertight compartment.

Dedicated oily water and sludge tanks shall be provided. An electric driven oily water pump and sludge pump shall be provided for pumping out oily water and sludge respectively.

Oily Water Separator

One (1) Oily water separator of approx. capacity as per the requirements specified in the rules & regulations in para 0.F meeting relevant regulatory requirements shall be provided.

81 FIRE FIGHTING AND EMERGENCY SYSTEMS

811 FIRE DETECTION SYSTEM

In general, fire detection system shall be provided adhering to relevant Class/Statutory Regulations.

This shall consist of an addressable fire & smoke detection system in all compartments, including the battery room, machinery room and all stairways, corridors, escape routes within accommodation spaces, etc. The detectors shall be of smoke/heat or thermal type dependent on location of installation.

Gas detection system is to be installed in battery room as per class requirement. Arrangements are to be provided for automatic exhaust of the developed gases when detected. Battery chemistry including manufacturer recommendations are to be considered, whilst selecting the system.



813 ONBOARD FIRE FIGHTING AND DECK WASH SYSTEM

The firefighting and deck wash system shall be supplied by a dedicated fire pump and a Bilge/GS/Fire pumps. The fire pumps shall be provided as below:

- a. At least two fire pumps having a total capacity as per the requirements specified in the rules & regulations in para 0.F. This may be met by combination of a fire pump and a bilge/GS/fire pump.
- b. There shall be an independently driven emergency fire pump having a minimum capacity as per the requirements specified in the rules & regulations in para 0.F.

In addition, other firefighting equipment as per the requirements of class and regulatory bodies shall be provided.

815 ENGINE ROOM FIRE FIGHTING SYSTEM

A fixed gas-smothering type fire suppression or "CO₂" gas flooding fire extinguishing system shall be installed in the engine room, in accordance with the requirements of the Regulatory Bodies. Other compact and environment friendly options such as FM 200 or NOVEC 1230 may be considered based on Buyer's preference.

Battery Room Fire Fighting

Firefighting system for battery shall be as per the requirements specified in the rules & regulations in para 0.F

==OPTION START==

816 EXTERNAL FIRE FIGHTING SYSTEM (OPTIONAL)

An external fire-fighting system shall be fitted, comprising of engine driven PTO pumps, fire monitors and water spray system, meeting FIFI 1 requirements of the selected class.

Fire pumps may be arranged in any of the configurations below:

One/two no. fire pump connected to Diesel Generator PTO. The fire pump shall have a dedicated sea chest.

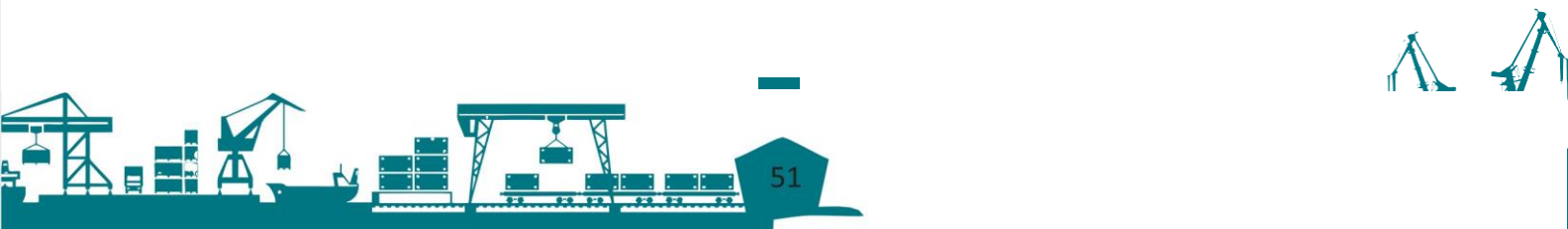
Fi-Fi Pumps

The FiFi pumps shall provide sufficient water to two fire monitors and water spray system.

- Type Centrifugal
- Drive Diesel Generator PTO
- Total Capacity min. 2800 m³/hr (meeting FIFI 1 requirements of the selected class)

Foam System

Foam tank(s) of total capacity 10,000 litres, complete with necessary fittings shall be



provided. The system shall be provided with line proportioner for foam mixing. The foam type shall be AFFF.

Fi-Fi Monitors

Two (2) single barrel dual purpose monitors each having capacity as per FIFI 1 requirements of the selected class.

Water Spray System

The vessel shall be provided with self-protection measures as required by FIFI 1 requirements of the selected class.

These measures shall include fixed water-spraying system for protection of all outside vertical areas of hull, superstructures and deckhouses including foundations for water monitors and other equipment.

The capacity of fixed water-spraying system shall be provided to meet class requirements. The capacity shall not be less than 10 litres per min. per [m2] of the areas to be protected. For areas internally insulated to class A-60, however, a capacity of 5 litres per min. per [m2] may be accepted.

The arrangement for water-spraying system is to be such that necessary visibility from the wheelhouse and the control station for remote control of the firefighting water monitors can be maintained during water spraying.

Fi-Fi Control System

Fire monitors shall have controls for both wheelhouse and local operations. Wherein, a fixed control panel shall be mounted in the wheelhouse with the operator having unrestricted view on the Fi-Fi monitors.

==OPTION END==

82 OVERFLOW, AIR & SOUNDING SYSTEM

General

Air vents shall be installed for all tanks having filling or suction connections.

Air vents in fuel oil tanks and sludge/oily water/sewage tanks (as applicable) having flammable hydrocarbon shall be provided with flame screen. Foam and dispersant tanks are to be given with a P/V (Pressure/Vacuum) vent.

Diesel Oil bunker stations shall be arranged on both port and starboard side. Connectors for fuel oil filling shall be of camlock type. For freshwater filling, threaded type connectors shall be provided.



822 MANUALSOUNDING

Sounding provisions shall be provided for all tanks as far as practicable. Manual Sounding system shall be in general of sounding pipe type. Sight glasses to be provided for small tanks, if possible.

823 AUTOMATIC/REMOTE SOUNDING SYSTEM

A Remote Tank Level Indications system shall be provided for FO Service tanks, in addition to local tank level gauge.

All other hull tanks may be provided with remote tank level indication as per buyer's requirement.

85 COMMON ELECTRONIC & ELECTRICAL SYSTEM

General

Electrical work in the ship shall be carried out in accordance with this specification, the Builder's standard and in compliance with classification rules. The type and construction of the electrical equipment shall be in accordance with the manufacturer's standard unless specifically stated.

The design of the electric plant including generators, motors and controllers shall be co-ordinated to ensure that the voltage dip, when starting the motor with highest inrush current shall not exceed 15% of the rated voltage.

Power Generation and Distribution

Sufficient Batteries shall be provided for completing the operating profile of the Tug in the operating ports. Batteries shall be able to work with on board DGs to work in case of increase in the endurance period. 2 Nos. main generators each catering for vessel load as per section 861 shall be provided.

Generators are to be provided with Floating neutral.

Electric power supplies available onboard: -

- a) 1000V DC or any other suitable voltage
- b) 415V, 50 Hz, 3phase, 3 wire
- c) 230V, 50 Hz, 1 phase, 2 wire
- d) 24V DC

86 ELECTRIC POWERSUPPLY

861 GENERATORS

Main Generators

Power Rating Min. 1X 940kW + 1x 560 Kw or any other Suitable combination



| | |
|-----------------|---|
| | meeting the requirements defined below. |
| Voltage | Low Voltage & can be 50/60 Hz, 3Ph, 3 wire |
| Insulation | Class-F/F |
| IP | as per class rule |
| AVR | Solid state design or as per maker standard |
| Excitation | Self-excited, self-regulating type with brushless excitation system |
| Type of cooling | Engine shall be FW/SW cooled Alternator shall be air cooled or water cooled as per OEM Standard. |
| Starting | Electric Start |

At least 2 nos. of generators shall be provided. Generators shall be as per the norms of classification society rules. Generator ratings indicated are preliminary values. The builder shall carry out separate load calculations at the time of construction based on the actual electrical rating of equipment to arrive at final load rating of the generators.

Voltage and frequency tolerances shall be within the limits specified by the Class rules. Generator space heaters shall also be provided for each generator.

Total Generator capacity shall be sized based on the largest of the below criteria:

- Generator shall be capable of driving External Fi-Fi pump if available through shaft and sufficient power for manoeuvring during firefighting operations.
- Total generating capacity equal to average power demand over one complete operation as per the operating profile (Based on Port data) to allow sufficient capability to perform continuous operations.
- Total generating capacity shall cater for at least 8 knots speed of the vessel.

865 TRANSFORMERS

All Transformer shall conform to class rules.

One (1) off Transformer (415V/230V) as per requirements of lighting/services of sufficient capacity shall be connected main switchboard for catering the vessel's power supply requirements.

One additional transformer shall be provided for redundancy.

The final quantity & capacity of transformers shall conform to class requirements.

866 DC SYSTEM

24V Battery Charger & Distribution Board

At least One (1) battery charger with distribution board shall be provided for charging and discharging of battery. The battery charger shall be of dead front and self-supporting type and of such arrangement that battery may be float charged. Necessary number of feeder circuit for consumers with fuses/MCB shall be provided.



General use batteries

At least One (01) set of storage batteries shall be installed in case of electric started engines.

One (01) set of storage batteries for navigation & communication equipment shall be installed either in a battery room or inside dedicated battery boxes placed at suitable location.

The batteries shall be maintenance free, Lead acid type, 24V DC.

868 ELECTRIC SHORE SUPPLY

AC SHORE SUPPLY

The vessel shall be provided with AC shore supply arrangement to cater for hotel load & Battery Charging.

Electrical interlocking of main generator breaker and shore connections breakers shall be provided in such a way that the shore connection breaker cannot be switched 'on' if any of main generator breaker is 'on' and vice versa. The shore supply cable shall be separate strand type and of adequate capacity to meet the harbour load and battery charging capacity. The shore supply cable shall be flexible.

Shore supply cable of 50 meters length shall be supplied by the builder for using in dry dock.

The Available shore power from port shall be at least 2000kVA, 690V, 50Hz, 3 ph.

The vessel shall be designed with necessary charging arrangements to charge the tug for one full harbour operation within 2 hours for the given operating profiles as per Para 869.

869 ENERGY STORAGE SYSTEM(ESS)

Energy Storage Systems, consisting of battery banks shall be provided for harbour operations/ peak shaving/standby operations of the vessel. Battery banks shall be split between two separate compartments with equal capacity.

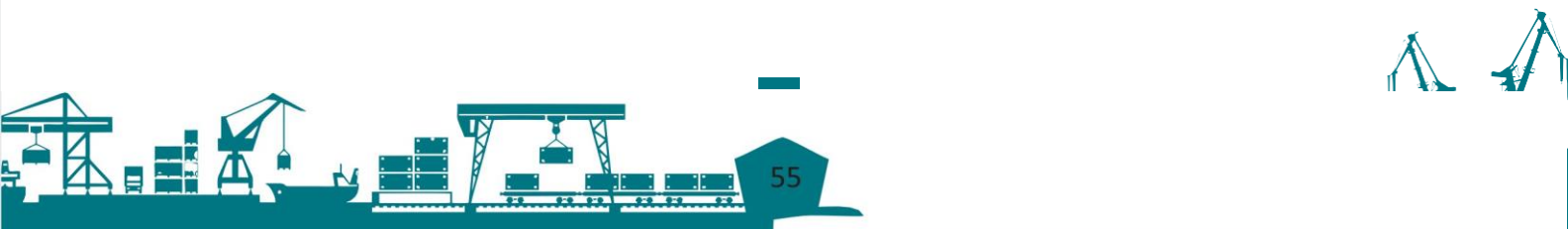
Battery can be air cooled, or water cooled as per the battery Manufacturer.

ESS shall be sized considering the below criteria for the vessel:

- ESS to cater for One full harbour operation of the vessel for given operating profile without the use of DG or to cater energy requirement for 30min of Full Bollard Pull of the Tug without the use of DG whichever is higher.
- ESS to be able to discharge 110% propulsion power to accommodate bollard pull and house loads
- ESS to be able to charge at rate to suit Port's operating profile and shore charging facilities
- Design life shall be at least 10 years.
- End of Life (EOL) usable State of Health (SoH) shall be at least 70%.

Emergency shutdown system to disconnect the battery system in case of emergency as per class requirements shall be provided.

Capacity: Approx. 5500-7000 kWh for NMC & Approx. 3200-4400 kWh for LTO depend on the



operating profile requirements (Other Chemistry can also be used based on energy requirement calculation). ESS will be provided with min. 2 Separate banks.

| | |
|--------------------|--|
| Classification | Approval as required by classification society |
| Expected Life time | 10 years |
| Charging C Rate | NMC: 0.5C-0.8C |
| LTO | 0.5C-0.6C |
| Discharge C Rate: | |
| NMC | 0.6C-0.75C |
| LTO | 1-1.1C |

The above charging & discharge rates are indicative, however the same should be catered as per the operating profile requirement without deviating the guidelines specified in this specification.

Cooling: Air cooled /Water cooled

BMS (Battery Management System): BMS should be capable of monitoring voltage, temperature, current etc. as per class requirement.

87 COMMON ELECTRIC DISTRIBUTION SYSTEM

871 DC & AC SWITCH BOARDS

DC Switch Board

The DC switch board shall be connected through bus tie /fuse with precharge circuit & contactor wherever necessary such that failure in one bus shall not be propagated to the other bus leading to complete shutdown. The voltage of the switch board shall be as per the part 85. The switch board shall be complete with and indications, protections etc required as per the class rules. DC switch board to be provided with suitable fuse /breaker after de selectivity studies. The switchboard shall be constructed according to Ip23.

The drives shall be part of the DC switch board so as to reduce the footprint area.

AC Main Switch Board

The main switchboard shall be self-supported, steel plated and dead front type. The construction of the panel board shall be of IP 23. The panel boards shall be manufactured from 14 SWG primed steel plate. The front shall be provided with hinged door locks and insulated hand rails. Oil resistant type mat shall be provided in the front of the switchboard.

Bus bar shall be of hard drawn high conductivity copper.

The entire bus bar system including supports and insulation shall be designed to withstand the thermal and magnetic stresses due to short circuit, up to maximum estimated fault level on main bus bar.



Provision for manual and semi auto synchronizing and paralleling of generators shall be arranged.

Breakers - MCCB/MCB's
 - bus tie breaker

Instrumentation on MSB shall confirm to class rules.

874 EMERGENCY STOP

Emergency stop system complying with Classification Rules shall be provided.

875 DISTRIBUTION PANELS

All distribution panels shall be made of primed steel with a painted surface. Cabinets shall have hinged door with catch and lock arrangement. The panels shall be provided with approx. 10% spare capacity of breakers.

Distribution panels for 415V

Distribution panels for motors, fans, galley-laundry equipment, heating fans etc. - MCB/MCCB shall be used.

Distribution panels for 230V

Distribution panels for general lighting, heating and other 230V equipment. - MCB shall be used.

Distribution panels for 24V

Distribution panels for electronic equipment, remote control etc. - MCB shall be used.

88 ELECTRIC CABLE

All cables shall be approved by the classification society (except special cables).

All cables to be of Halogen-free type.

The voltage rating of the cables shall not be lower than the nominal voltage of the circuit for which they are used.

0.6/1.0kV grade cables shall be used for all 415V installation and min 250V grade cables shall be used for all 230V and 24V power installations. Armoured Cables may be considered as per buyer/class requirement.

Cable in general shall have copper conductor and XPLE or EPR conductor insulation.

Sizing of the cables shall be as per the Classification Rule requirement.



89 ELECTRIC CONSUMER SYSTEMS

891 GENERAL LIGHTING IN ER, ACCOMMODATION ETC.

All engineering machinery compartments shall be illuminated in accordance with Class Rules.

All lighting fixtures shall be provided with enclosures having IP ratings indicated below:

| | |
|--------------------------------------|------|
| Light fixture in dry accommodation | IP20 |
| Light fixture in galley, laundry etc | IP44 |
| Light fixture in engine room etc | IP44 |
| Light fixtures on open deck | IP56 |

Suitable number of sockets outlets, 230V, 15 A to be installed in engine room and workshop.

Non-water tight 230V, SA sockets to be installed in cabins, public spaces, lockers etc.

Two sockets shall be fitted in each cabin.

Two off three phase sockets of suitable rating for welding machines shall be provided at suitable locations as agreed between the Buyer and the Builder.

Lighting

The following may be catered as per Class Rules in general:

- LED Based Light fittings for entire ship.
- Provision for emergency lighting.

Navigation lights shall be provided as per Class Rules/COLREGs.

Machinery room

Machinery room lighting shall be arranged to provide proper illumination as applicable as per Class Rules.

Suitable lighting shall be provided in workshops & outside of the ship.

Emergency Lighting

24V DC-operated Emergency light fittings shall be fitted to provide illumination to accessways and passageways. The emergency lighting system shall be as per class rules. In the event of failure of the ship's AC normal lighting 24V DC emergency lights shall be switched on automatically.



SECTION 3

**COMPLIANCE CERTIFICATE
TEMPLATE FOR GREEN TUGS**



Vessel Requirements

| | |
|----------------------|----------------------|
| Bollard Pull | <input type="text"/> |
| Length Overall | <input type="text"/> |
| Breadth moulded | <input type="text"/> |
| Navigational Draught | <input type="text"/> |
| Gross tonnage | <input type="text"/> |

Operation Profile

| Operation | Duration per cycle (mins) |
|------------------------------|---------------------------|
| Standby | <input type="text"/> |
| Steaming (Max speed) | <input type="text"/> |
| Transit Low< 6 KNOTS | <input type="text"/> |
| Transit High> 6 KNOTS | <input type="text"/> |
| High Bollard Pull >90% | <input type="text"/> |
| Medium Bollard Pull {50-90%} | <input type="text"/> |
| Low bollard Push/Pull< 50% | <input type="text"/> |

Total Operation Duration per cycle mins

Number of Cycles per Day Nos

Shore power for charging kW

Technical Parameters

Estimated Energy Demand for one operation kWhr

Estimated Fi-Fi Power Consumption kW

Estimated Hotel Load kW

Estimated Propulsion power to achieve 100% of Bollard Pull kW



1. Generator Capacity:

| Sl. No | Parameters | Vessel Detail | Remarks |
|--------|--|---------------|---------|
| a) | Fi-Fi Power Consumption+ Hotel Load | kW | |
| b) | Average power demand over one complete operation as per the operating profile (Based on Port data) | kW | |
| c) | Power Required for at least 8 knots speed of the vessel. | kW | |
| d) | Largest of (a), (b), (c)-Required generating capacity | kW | |

The above-indicated values are based on preliminary estimation for the project. The above is subjected to change based on Final Vessel design & specification.

2. Energy Storage Capacity:

| Sl. No | Parameters | Vessel Detail | Remarks |
|--------|--|---------------|---------|
| a) | Energy Demand for One full harbour operation of the vessel as per the given operating profile. | kWhr | |
| b) | Energy requirement for 30 min of Full Bollard Pull of the Tug | kWhr | |
| c) | Largest of (a), (b)-Required energy | kWhr | |
| d) | Estimated battery capacity considering 10 yrs & EOLSoH of 70% | kWhr | |

The above indicated values are based on preliminary estimation for the project. The above is subjected to change based on Final Vessel design & specification.

3. Guideline Specification:

The vessel will be built as per Guideline Specification issued by IPA.

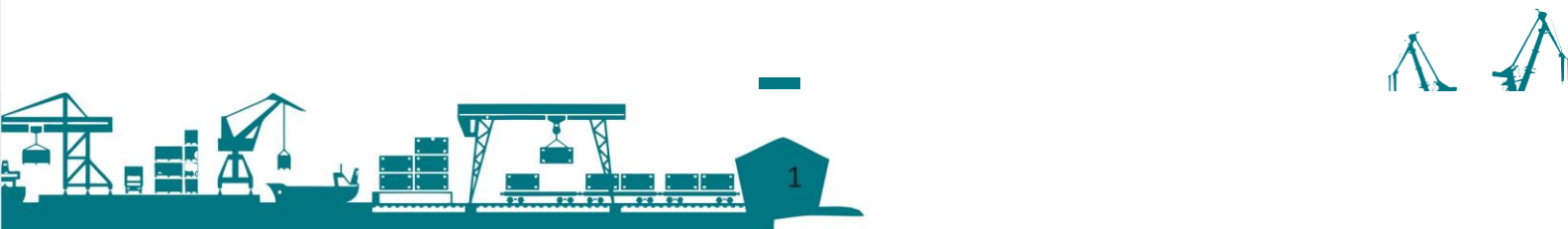
4. Declaration:

It is declared that vessel shall be designed & built as per the requirements specified in the guideline specification published by IPA and the GTTP compliance certificate issued by recognized classification society will be submitted during the induction of Tug into port operations.

Authorised Representative of the Tenderer

Supporting Documents for Certification:

1. Estimated Energy Calculation with respect to operating profile



Vessel Information

| | |
|------------------------|----------------------|
| Tug Name | <input type="text"/> |
| Owner | <input type="text"/> |
| Bollard Pull | <input type="text"/> |
| Hull Number | <input type="text"/> |
| IMO Number | <input type="text"/> |
| Classification Society | <input type="text"/> |
| Length Overall | <input type="text"/> |
| Breadth moulded | <input type="text"/> |
| Navigational Draught | <input type="text"/> |
| Gross tonnage | <input type="text"/> |
| Compliments | <input type="text"/> |
| Built By | <input type="text"/> |

Operation Profile

| Operation | Duration per cycle (mins) |
|------------------------------|---------------------------|
| Standby | <input type="text"/> |
| Steaming (Max speed) | <input type="text"/> |
| Transit Low< 6 KNOTS | <input type="text"/> |
| Transit High> 6 KNOTS | <input type="text"/> |
| High Bollard Pull >90% | <input type="text"/> |
| Medium Bollard Pull {50-90%} | <input type="text"/> |
| Low bollard Push/Pull< 50% | <input type="text"/> |

Total Operation Duration per cycle mins

Number of Cycles per Day Nos

Shore power for charging kW



Technical Parameters

| | |
|--|------|
| Energy Demand for one operation | kWhr |
| Total Duration of one operation | mins |
| Fi-Fi Power Consumption | kW |
| Hotel Load | kW |
| Propulsion power to achieve 100% of Bollard Pull | kW |

1. Generator Capacity:

| Sl. No | Parameters | Vessel Detail | Remarks |
|--------|--|---------------|-------------|
| a) | Fi-Fi Power Consumption+ Hotel Load | kW | |
| b) | Average power demand over one complete operation as per the operating profile (Based on Port data) | kW | |
| c) | Power Required for at least 8 knots speed of the vessel. | kW | |
| d) | Largest of (a), (b), (c) | kW | |
| e) | Number of Generators installed onboard | Nos | ∴2 |
| f) | Total Generator capacity installed onboard | kW | |
| g) | Generator Size acceptable (f > d) | Yes D | No 0 |

2. Energy Storage Capacity:

| Sl. No | Parameters | Vessel Detail | Remarks |
|--------|--|---------------|---------|
| a) | Energy Demand for One full harbour operation of the vessel of given operating profile. | kWhr | |
| b) | 110% propulsion power to accommodate bollard pull and house loads | kW | |
| c) | Energy requirement for 30 min of Full Bollard Pull of the Tug | kWhr | |
| d) | Design Life of Battery | yrs | ∴10 |
| e) | End of Life State of Health | | ∴70% |
| f) | Largest of (a), (c) | kWhr | |
| g) | Total Battery installed capacity onboard | kWhr | |
| h) | Number of battery banks installed onboard | Nos | ∴2 |



| | | | |
|----|---|------------------------------|-----------------------------|
| i) | OEM declaration on battery sizing for design life mentioned in (d) and End of Life Depth of Discharge (e) | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| j) | Allowable Charge Rate of the installed battery to meet d) & e) | | |
| k) | Allowable Discharge Rate of the installed battery to meet d) & e) | | <input type="checkbox"/> |
| l) | Is discharge rate in k) meets the condition in b) | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| m) | Is charge rate in j) meets the operating profile and shore charging facilities | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| n) | ESS Capacity acceptable | Yes <input type="checkbox"/> | No <input type="checkbox"/> |

3. Guideline Specification:

The vessel is built as per Guideline Specification issued by IPA.

☐ No

The Tug meets all the requirements as per para 1, 2 & 3.

Based on the above data, it is certified as the tug is GTTP Compliant.

Authorised Representative of the Classification society

Supporting Documents for Certification:

1. Classification Certificate
2. Bollard Pull Certificate
3. Energy Calculation with respect to operating profile
4. Battery OEM declaration on Battery Sizing
5. Thruster Performance curves

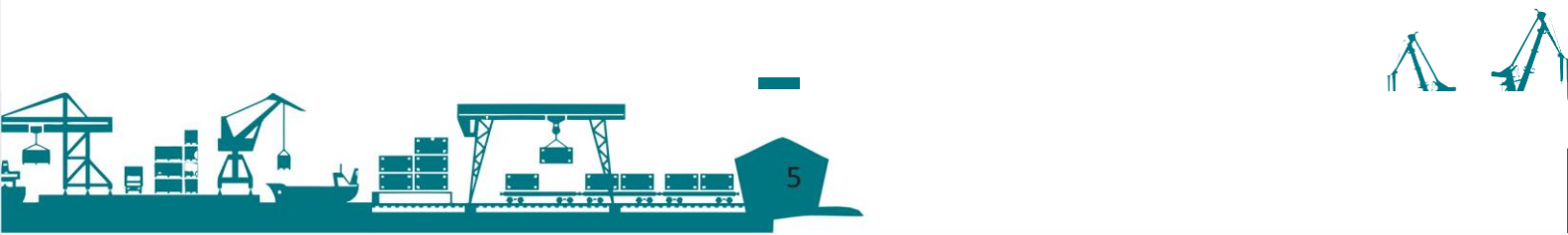


Annexure 1- Recognised classification Societies

The list of recognised classification societies are as follows.

- IRS-Indian Register of Shipping
- ABS-American Bureau of Shipping
- Bureau Veritas
- **DNV-GL**
- LR- Lloyd's Register
- ClassNK-Nippon Kaiji Kyokai
- RINA

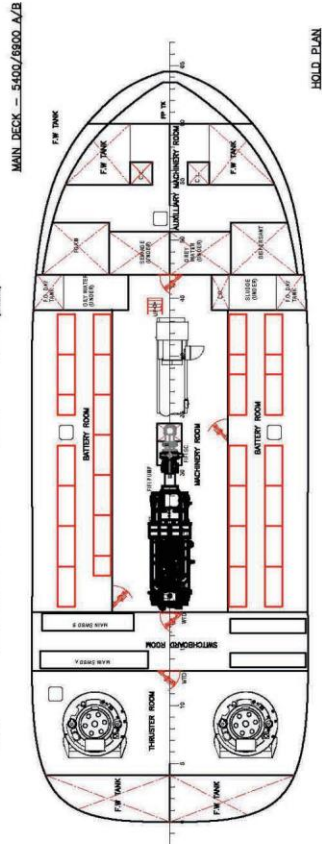
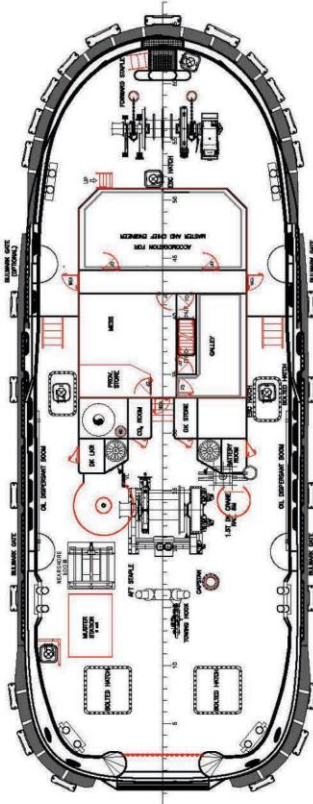
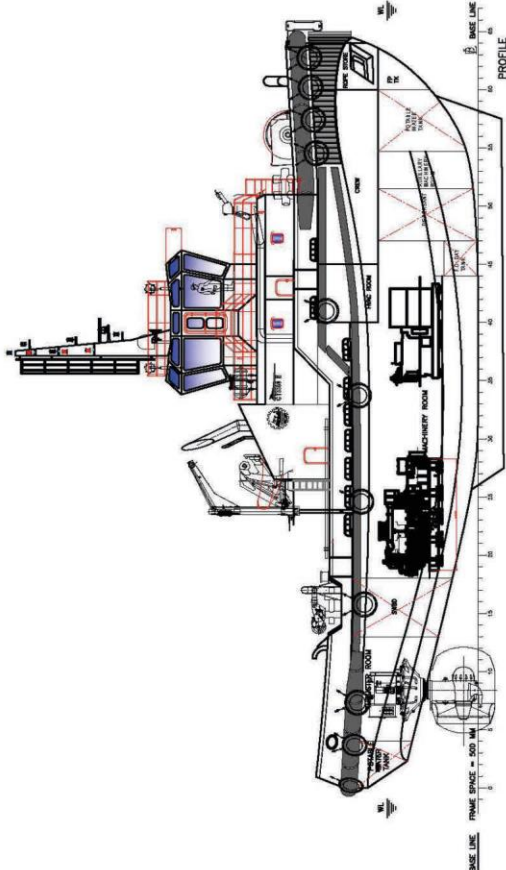
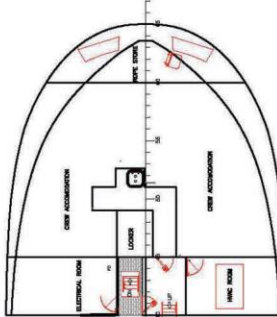
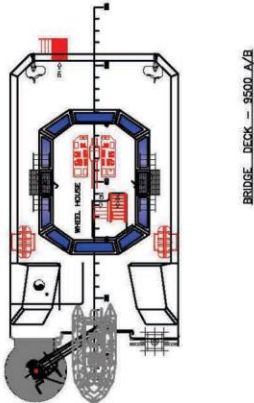
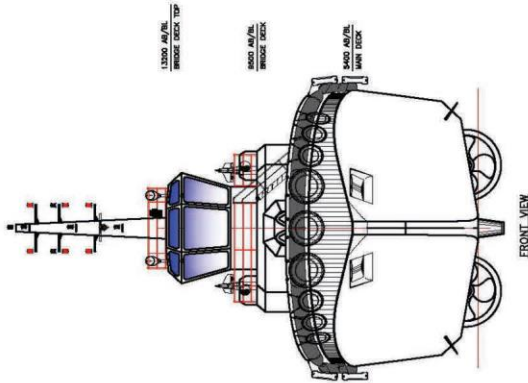
Note: The above list shall be amended as and when DGS issues recognised organisations circular.



SECTION 4

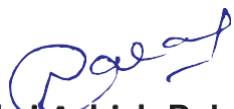
GENERAL ARRANGEMENT PLAN



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DECLARATION BY STANDING SPECIFICATION COMMITTEE

The Technical Specification Document for Phase 1 of the Green Tug Transition Program of Ministry of Ports, Shipping and Waterways has been prepared, vetted and endorsed by all the members of the Standing Specification Committee.



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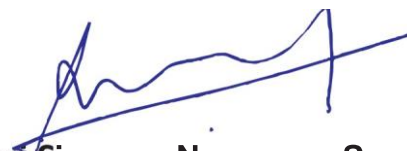


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**Ministry of Ports, Shipping and Waterways
Government of India**