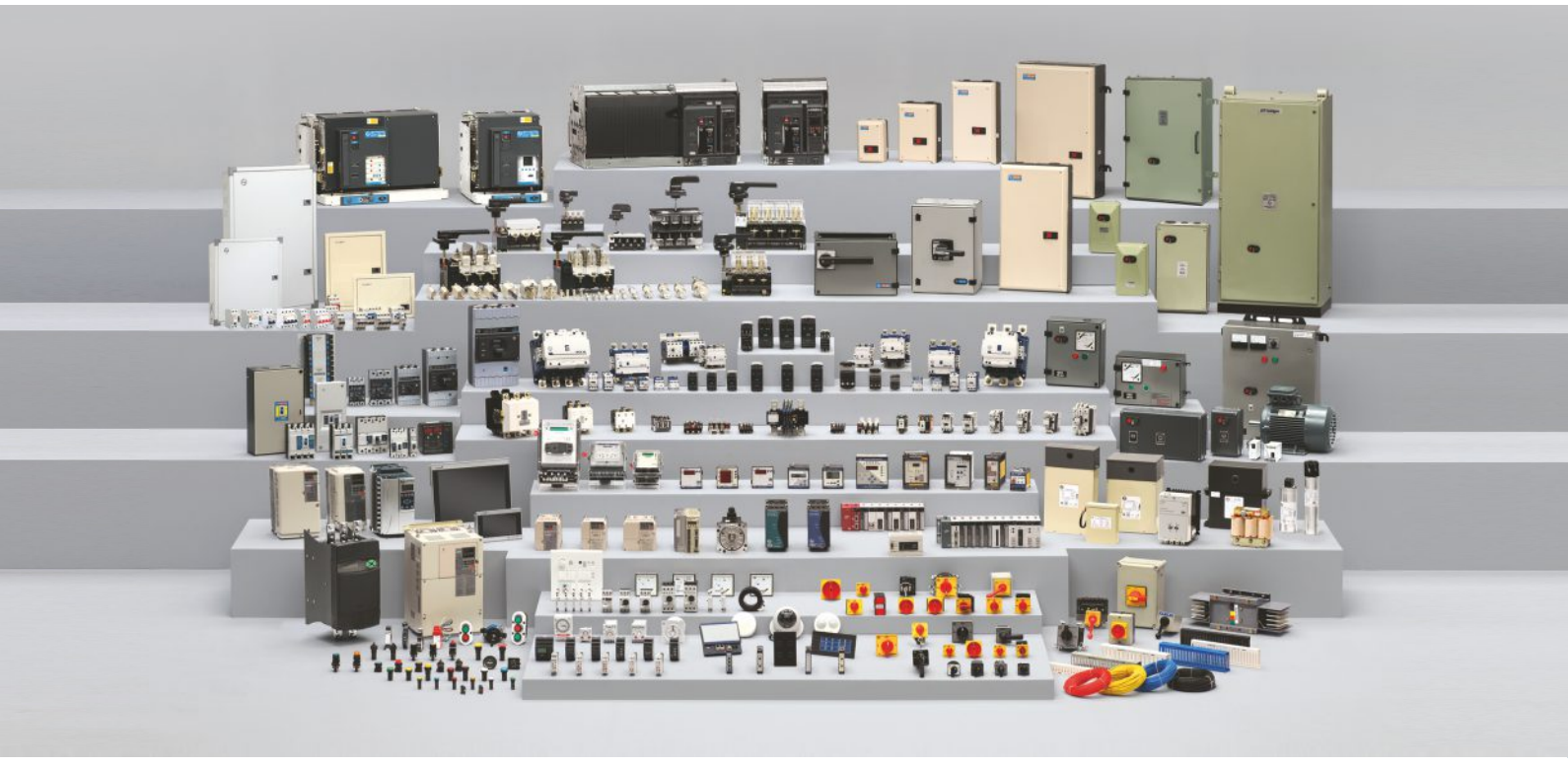
One-stop Solution

Marine Switchboards and Control Systems

L&T Electrical & Automation

THE LEADER IN SWITCHGEAR & SYSTEM SOLUTIONS

L&T is India's largest switchgear manufacturer, offering wide product ranges for virtually every application. Leveraging its technological resources, L&T is committed to offer indigenously engineered system solutions to customers.



The expansive range of switchgear offered by L&T.

Typically, L&T engineers conduct a detailed study of the customer's system, and provide a professional analysis of the application along with recommended cost-benefit solutions. The spectrum:

- Innovative and Totally Re-engineered solutions
- Retrofit solutions
- System up-gradation

L&T's switchgear spectrum stretches from Push Buttons to Air Circuit Breakers. L&T's leadership goes far beyond the range to include a number of factors like:

- Volume – L&T manufactures over 36,000 ACBs and 32,000 switchboard panels every year.
- Sophistication of indigenous manufacturing facilities.

Investment in R&D – facilities include 85kA test station that is NABL accredited and certified by KEMA. A camera taking 33000 frames per second to study dynamic behavior. Concurrent engineering with a sophisticated set-up uses Pro-E/ Inventor to convert design conceptualization to manufacturing drawings. Every design is vetted using ANSYS software for its shock and vibration withstand capability.

Quality assurance – Facilities have secured ISO 9001-2008 certification and are NABL accredited.

L&T had entered into a long term partnership with M/s Servowatch, UK for execution of IPMS projects. M/s Servowatch has a rich experience of over 35 years in IPMS and equivalent projects. They have proven track records in many navies including U.K., Australia, New Zealand, Thailand, U.S.A., Portugal etc. Together, L&T and Servowatch have ushered in cutting-edge technology in the Indian Navy with Servowatch providing the state-of-the-art technology and L&T spearheading Indigenisation and Life Cycle Support in line with the country's drive in attaining Self Reliance in Critical Defense Projects. Subsequently, L&T has acquired Servowatch & is a subsidiary company of L&T.

ACB Assembly Shop where over 36000 ACBs are manufactured per year.

PRODUCT RANGE

Type approved Marinised Switchgear

Air Circuit Breakers (ACB)

A product list indicative of L&T's comprehensive range of products and systems certified for naval application (JSS55555).

- 630-9000A range
- Three & four pole version
- Fixed and draw-out version
- Manual or electrically operated version
- Breaking capacity up to 100kA
- Supported with range of protection releases
- Replaceable arcing contacts, safety shutters for extended life & safety
- Complying with IEC 60947-2, EN 60947 -2
- AC & DC application

Protection Relays

- Generator protection
- Auto-synchronization
- Load sharing / shedding
- Motor protection Relays (IPMS Compatible)

Changeover Systems

- Manual
- Automatic with fast changeover switches (<15 msec Changeover time)

L&T Switchgear is Certified by:

- Director General of Quality Assurance (DGQA) Indian Navy
- American Bureau of Shipping (ABS)
- Indian Register of Shipping (IRS)
- Det Norske Veritas (DNV)
- Lloyd's Register of Shipping (LRS)
- Bureau Veritas (BV)
- Germanischer Lloyds (GL)
- RINA
- Nippon Kaiji Kyokai (NK)

Moulded Case Circuit Breakers (MCCB)

- 16-1250A range
- Three & four pole versions
- Separate ranges for different breaking capacities
- Fixed, plug-in and with-drawable versions
- Manual, rotary and electrical operation
- Low let-through energy
- Low watt loss
- Compact design
- Common & easy to fit accessories
- Use of environmental friendly material
- Comply with IEC 60947-2, EN 60947-2
- AC & DC application

Type approval Certification

Machinery Control Systems (Motors & Starters)

- Composite offering of Starters along with Naval Duty Motors
- Direct-On-Line Starter
- Star-Delta Starter
- Soft Starter (AC & DC application)
- Designed as per EED-Q-071 & IEC 60947
- Microprocessor based Motor Protection Unit
- IPMS-compliant
- Relay based/PLC based controls available

Custom-built Switchboards

Switchboards are designed and manufactured up to 690V, 6000A, 100KA

Features of Custom-built Switchboards

- Rated up to 6000A
- 690V / 440V / 380V / 230V Voltage Levels
- Fault withstand capacity up to 100kA
- Compatible with intelligent systems
- Designed to offer highest operational safety and reliability
- Customized dimensions and arrangement to suit customers requirements
- Integrated with APMS
- Ready for IPMS integration
- Available in Aluminum, Stainless steel, & Mild steel enclosures

Energy Distribution Center

Range of standardized starters - DOL, Star Delta, Soft Starter

Main Switchboard with APMS functionality

Switchboard for shore support facility

Retrofitted Main Switchboard with APMS Console

MCR Console with Platform Management System

MV Switchboards

- Type approved MV Panel up to 36 kV system voltage
- Complete range from 630A to 4000A
- Short time rating up to 40 kA for 3sec
- Metal clad, fully compartmentalized panel
- Internal arc compliant as per IEC 62271-200
- In-built comprehensive safety interlocks
- Integrated with hybrid as well as eectric propulsion system

Automated Power Management System (APMS)

- Automatic Generator synchronizing & load sharing
- Load Shedding
- Islanding
- Generator Protection
- Event Logging
- Fault/Alarm History
- Trending
- Blackout Recovery

Integrated Bridge System (IBS)

- Centralized Control of Navigation Equipment:
  Radar
  ECDIS
- Integrated GMDSS and Communication Equipment
- Redundancy of workstation
- Expandability
- Dual Redundant Network
- Navigation and communication equipment for centralized monitoring and control
- Interface with IPMS, Machinery Data

Integrated Platform Machinery Control System (IPMCS)

Control and Monitoring of:

- Main Propulsion Machinery and associated systems
- Auxiliary Propulsion Machinery and associated systems
- Auxiliary machinery and systems
- Power Management System
- Battle Damage Control System
- Bilge & tank levels
- Fire Alarm and Flood Level Indications
- Vibration Monitoring

Features

- Integrated Onboard Training Simulator
- Online Health Monitoring
- Performance Prediction
- Dynamic Analysis & Engine Performance
- Mimics providing sensor information and control function for machinery and other equipment.
- Common Dual Redundant Gigabit Network for all functions viz. IPMS, IBS and APMS.
- Standard RTU configuration for all function viz. IPMS, IBS and APMS

Integrated Bridge System

Machinery Control System

Machinery Control Console

Alarm Monitoring System (AMS)

The Alarm system provides the following facilities:

- User Configurable Alarm Parameters
- Alarm Status (Active / Reset, Acknowledged)
- Alarm Message (Text description, time & date)
- Online alarm printing
- Database for Alarm list & Event List
- Engineers Call system
- Alarm Acknowledgment by individual alarm or alarm page
- Online event printing
- Comprehensive Alarm
- Event browsing facilities
- Alarm Blocking
- Tagging for selected signals

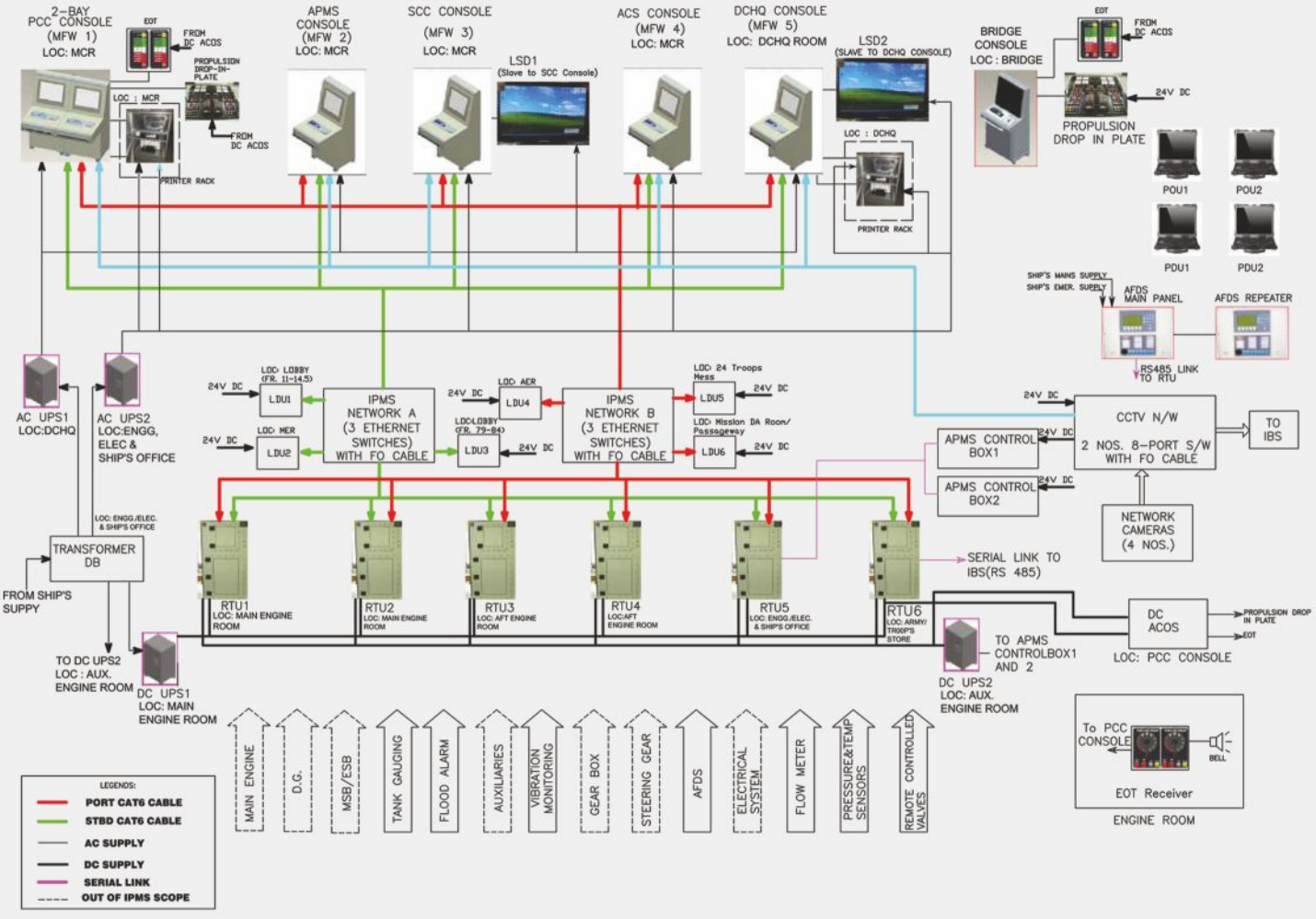
The Alarm Monitoring System architecture is laid out in 3 levels of architecture:

- Data acquisition level
- Network level
- HMI

The status of following parameters will be monitored by alarm & monitoring system:

- Temperature sensors (PT 100, thermocouple)
- Pressure transmitters (4 ~ 20 mA)
- Pressure switches
- Speed sensors
- Temperature switches
- Level switches (Float type)
- Level transmitters

Standalone IBS Console



Typical architecture for IPMS / AMS

Vessel Management System (VMS)

The Vessel Management System (VMS) has a provision for continuous monitoring and time-based records of various parameters like temperature pressure level, etc for ship systems like Main Engine and Diesel Generators, Bilge System, Advanced Fire Detection Systems (AFDS), Pressure Air System, Thruster System and so on. The System has DACU (Data Acquisition Control Unit), rugged PC workstation (for monitoring and controlling), and communication network. The system monitors various parameters like Temperature, Pressure, Speed, etc. and generates Audio Visual alarms in case of their abnormality; it also helps to take appropriate action for safe navigation of ship. VMS also controls various motors and pumps.

Key Advantages:

- Modular System Approach
- Dual Redundancy For Key Functions
- Fully Type Approved Equipment
- Tested, Certified System dispatch
- Redundant Array of Independent Disk (RAID) in the Machinery Control Room offering comprehensive monitoring and control of the ships services.
- Expansion flexibility, allowing continual network upgrade and development.
- Life Cycle Support.

Alarm annunciation and displays will be in the following formats:

- LED Annunciator display at each DACU
- 2 line LCD Operator Interface Unit at each DACU
- Tracker ball controlled PC monitors
- Engineers Alarm System
- Dead Man Alarm System

Degaussing - The magnetic signature control system

Sea mines and torpedoes detect a vessel's magnetic signature and attack the particular type of vessel based on its specific magnetic signature.

To save a vessel from these attacks, a counter-magnetic field has to be generated onboard vessel. This system which generates required counter-magnetic field in three axes is a Degaussing System.

L&T has successfully indigenized the degaussing system to suit naval vessels operating at various locations throughout the globe. The indigenized solution reduces the cost of the system substantially and also reduces MTTR for such an important system. Our Degaussing system can be custom built for:

- Frigates
- Air Defence Ships
- Corvettes

- Minesweepers
- Destroyers
- Offshore Patrol Vessels
- Submarines
- Retrofitment projects

Our offerings:
- Degaussing coil design and layout
- Completely indigenized yet fully type tested hardware including
  - Command and Control Unit
  - Power amplifier
  - Degaussing Coils
- Degaussing software - custom built as per the magnetic signature of the vessel

Salient features
- A promised Degaussing ON/OFF Ratio 1:10 for all the solutions over time
- Modular distributed architecture resulting in reduction in MTTR
- Easy and fast installation, maintenance and repair of the system
- Cost effective
- High reliability
- Geo Mag maps based control
- Provision of Magnetometer Sensing Modes (Auto & Manual)
- Communication through Ethernet or RS 485
- Configurable regarding expected Degaussing Ratio
- Warnings and alarms management

LAND DEPERMING RANGE

A Land Magnetic Deperming Range is a facility for magnetic treatment of machine parts to minimize their magnetic signature caused by magnetic stray fields. This requires both, generating high magnetic fields and precise measurement of small fields in arbitrary magnetic environment.

The objectives of the land range are:
- Reduction of the magnetic signature of components
- Measurement and analysis of magnetic stray fields of military covering the range from DC to over 3 kHz.
- Formulation and analysis of new magnetic treatment and compensation methods
- Analysis of magnetic stability
- Fundamental research for generating small magnetic signatures

A complete Degaussing Range comprises:

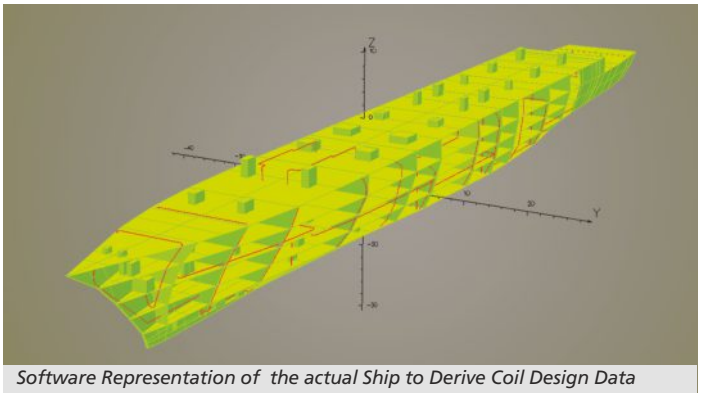
- Magnetic Multi Channel Measurement System
- Master Control Unit
- Software
- Magnetic Field Simulator
- Magnetic Degaussing Unit
- Nonmagnetic Building
- Nonmagnetic Trolley System
- Nonmagnetic Rail Guiding System
- Crane System

DEPERMING RANGE

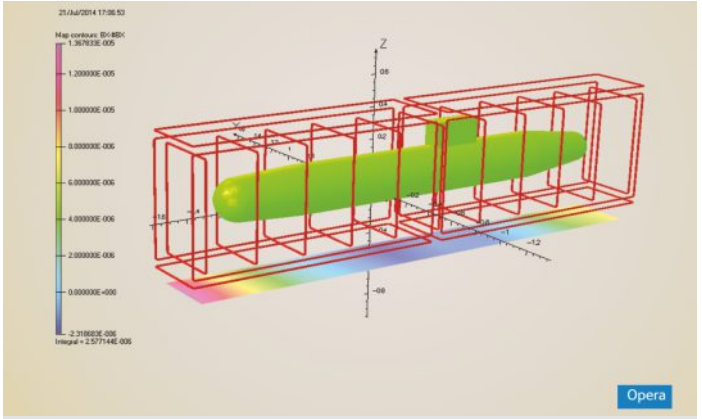
A Deperming Facility removes the permanent signatures or generation of well defined permanent signatures of naval vessels after ascertaining the magnetic signature levels.

The facility can also be used to calibrate onboard Degaussing systems to ensure minimal signatures.

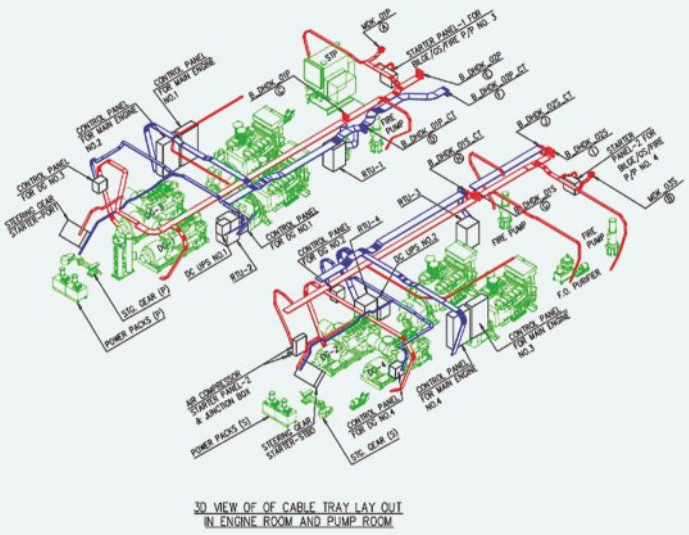
Degaussing Power Amplifier Cubicle with Control & Command Unit



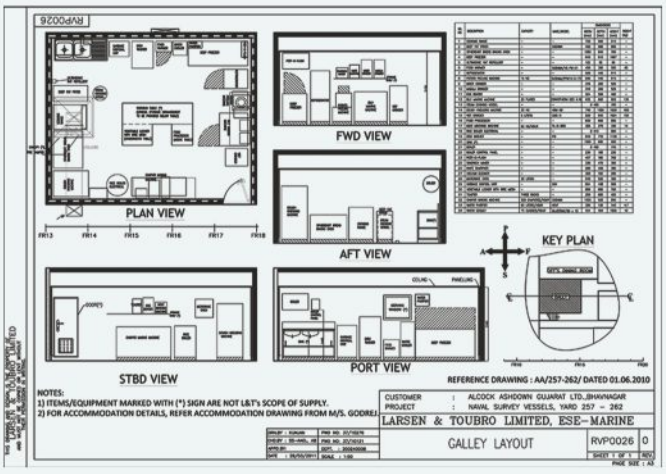
Software Representation of the actual Ship to Derive Coil Design Data



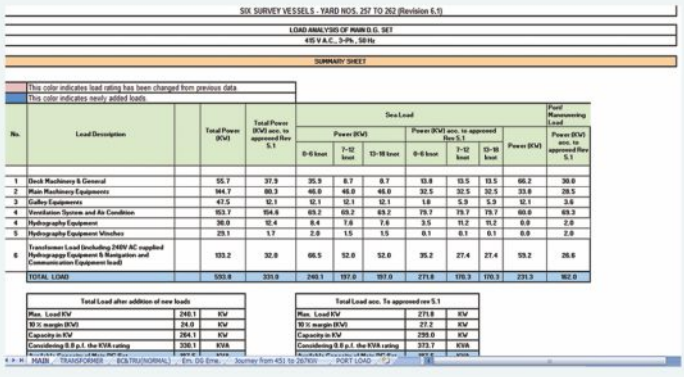
Deperming Calculations for Submarine



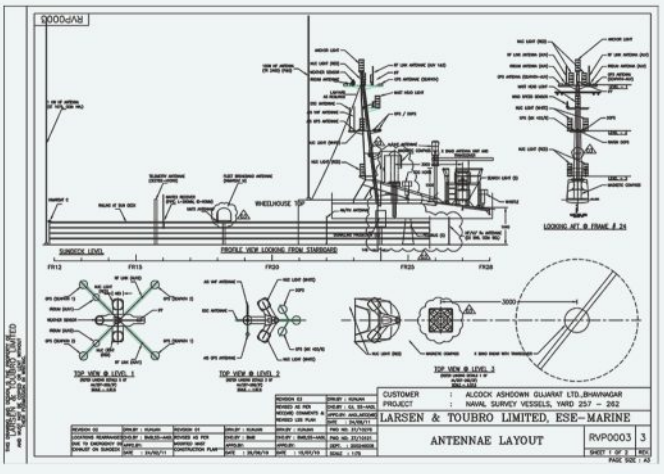
3D Layout for Cable Tray Arrangement



Compartment Layouts



Preparation and Submission of Load Analysis

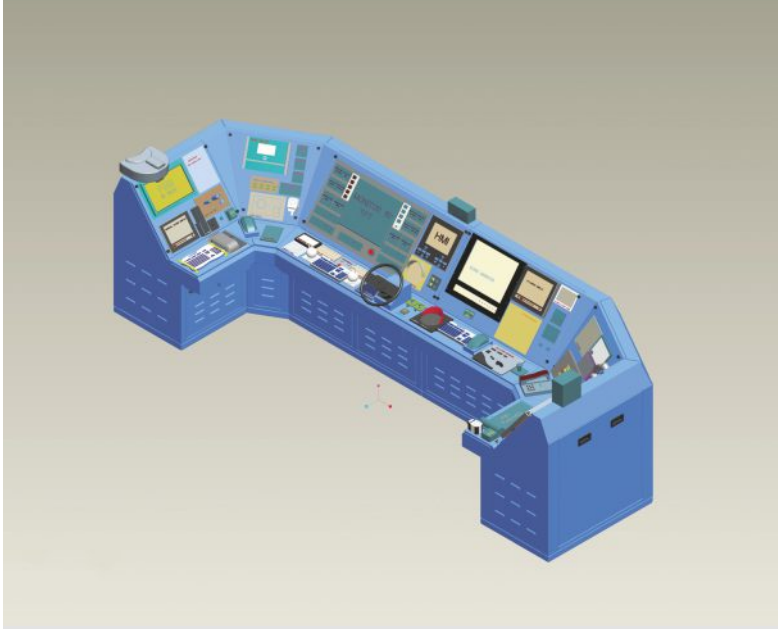


Antennae and Mast Layouts

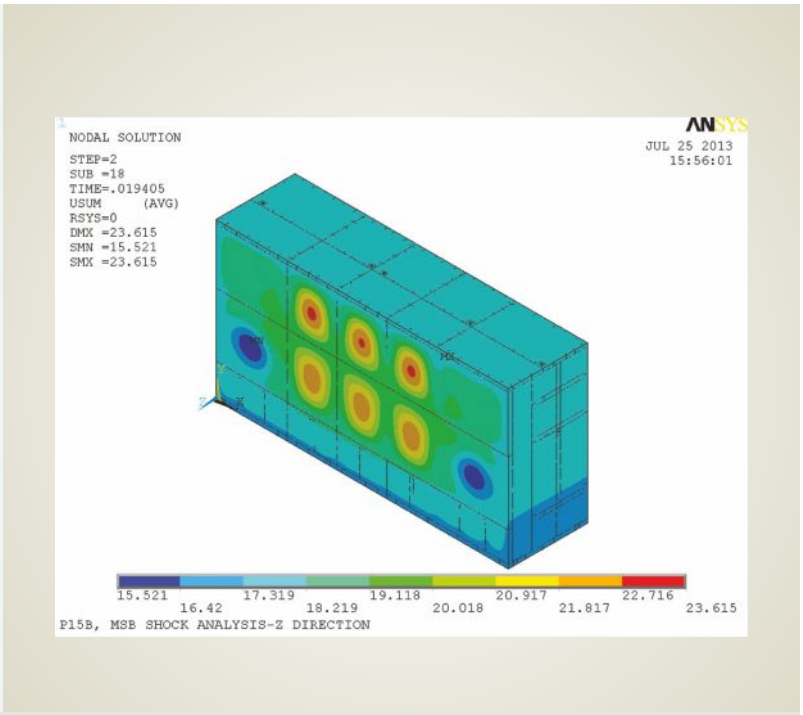
Turnkey solutions

- Finalization of DG set capacity and load distribution after approval of load analysis and single line drawing by classification society / owners
- Design & Supply of Class / Navy approved Main Switchboards, Group Starter Panels, Distribution boards, Transformers, TRUs, DCDBs, NLCP etc.
- Design of shipboard electrical
  - Short Circuit Calculation, Protection Co-ordination
  - ANSYS Analysis
  - Cable tray layouts and cable schedules
  - Equipment Location layouts, Lighting calculations and lighting layouts
  - Compartment layouts for Galley, Chart Room, Bridge, MCR, Gyro cum ECP room, WT Office, Antennae Layout as per IMO guidelines
  - Finalization of navigation & communication equipment in accordance with SOLAS requirements
  - COLREG-compliant LSS plan
  - FMEA analysis for switchboards / control system
  - Wiring drawings for the Integrated Platform Management System / Alarm Monitoring System
  - As fitted drawings for all electrical sub-systems
- Design of wiring drawings for yard-supplied equipment
  - Main Engines, Main DG sets, Emergency DG Set, STP, AC Plant, Pumps & other machineries
  - External Communication Equipment – VHF/UHF sets, VLF sets, HF sets, etc.
  - Manufacturing, Installation and Trials of Electrical & Automation Systems
- Design, Supply & Installation of Integrated Propulsion and Machinery Control System (IPMCS) and Auto Power Management System (APMS) / Alarm Monitoring System (AMS)
  - Remote Terminal Units (RTUs) with VME / PLC technology
  - Drop-in plate for engine control with VME / PLC based control
  - MCR Console, Bridge Console and APMS standalone consoles

3D Modelling of Switchboard



3D Modelling of Console



ANSYS (Shock & Vibration) Analysis

Onboard Installation of electrical components including cabling and lighting

- Engine Order Telegraphs, UPS, Flood Alarm System, Fire Detection System, Tank Gauging System, Soft control for Main Engines and other auxiliary machineries i.e. bilge pumps, ventilation fans, salvage pumps, FM 200
- Equipment Health Monitoring System & Dynamic Analysis
- Naval Ships - Battle Damage Control System, Degaussing System

- Design, Supply & Installation of Integrated Bridge System
  - Bridge Management System including RADAR, Conning and ECDIS operation
  - Navigation & Communication Equipment i.e. RADAR, Gyro Compass, Magnetic Compass, AIS, Navtax, Weather Chart Facsimile, INMARSAT C, INMARSAT M, etc.
  - Intercom System, Auto Telephone System, Talk Back System
- Supply & Installation of electrical equipment including COTS items
  - Galley & Laundry Equipment
  - Office & SRE Equipment
  - WT & Decorative Light fittings, switch-sockets.
- Supply & Installation of Electrical Equipment including hot-work
  - Cable Trays, Cable Hangers, Multi Cable Transits (MCTs)
  - Equipment Foundation for Switchboards, Electrical equipment, Antennae, Lighting fixtures, IPMS equipment, etc.
  - External Communication Equipment
  - Hydrographic Equipment
- Additional Services
  - Installation of Hydrographic / External Communication Equipment
  - Completion of Alignment Survey for installation of Hydrographic equipment
  - Setting of voltage and frequency droops for DG sets & Manual Paralleling of DG sets

Major Orders
Naval Switchboards & Control Systems

Customer	Type of Vessel/Owner	Scope of supply in brief	Yard/ Hull No.	No. of Vessels	Year of Supply
Goa Shipyard Ltd.	Naval Offshore Patrol Vessel for Indian Navy	o Main switchboards with Automated Power Management System o Emergency Switchboard o Energy Distribution Centers o 440V Power Panels o Integrated Platform Management System	1194 1195 1196 1211	4	2008 - 2010
	Offshore Patrol Vessel for Indian Coast Guard	o Emergency Switchboard	1203 1204 1205	3	2009
Garden Reach Shipbuilders & Engineers Ltd.	ASW Corvettes for Indian Navy	o Degaussing System	3017-3020	4	2009
		o Converted Supply Switchboard			2008
	Water Jet fast Attack Craft	o Main Switchboard	2057-2066	10	2008
	Indian Coast Guard Inshore Patrol Vessel	o Main Switchboard	2072-2079	8	2010
	Mauritius Offshore Patrol Vessel	o Main Switchboard o Emergency Switchboard o Addressable Fire Detection System	3021	1	2012 & 2013
Alcock Ashdown (Gujarat) Limited	Naval Survey Vessel for Indian Navy	Complete Electrification including supply of all electricals like : o Main Switchboard o Emergency Switchboard o Group Starter Panels o Galley & pantry Equipment o Cables & accessories o Integrated Platform Management System o Auto Power Management System o Integrated Bridge System	257-262	6	Delivered for first two ships in 2009
Mazagon Dock Limited	Destroyers for Indian Navy	o Main Switchboards with Automated Power Management System o Feeder Sections o Energy Distribution Centers o Local Control Panel o Shore connection box o Converted Supply Switchboard o Helo-Starting rectifier o Bridge Console o Power panels o Starter & Control panels	12701 12702 12703	3	2006 - 2008
Indian Navy	Underwater Platforms	o Switchboards o Power Equipment	-	2	2011 - 2012

Major orders
Naval Switchboards & Control Systems

Customer	Type of Vessel/Owner	Scope of supply in brief	Yard/ Hull No.	No. of Vessels	Year of Supply
Indian Navy	RE Class of ship of Indian Navy	o Main Switchboards o Local Control Panel	-	1	2008
Indian Navy	Minesweepers of Indian Navy	o Main Switchboards	-	6	2005-2008
Shalimar Works	500T Fuel Barge for Indian Navy	o Main Switchboard	766 767	2	2009
Cochin Shipyard Limited	Indian Air Craft Carrier (P71) for Indian Navy	o Main Switchboard o Feeder section o Energy Distribution Centers o Power Distribution Boards	S-071	1	2012
Hindustan Shipyard Limited	50T Bollard Pull Tug for Indian Coast Guard	o Alarm Monitoring System	11160 to 11164	5	2011 to 2013
Bharti Shipyard	200T Water Barge for Indian Navy	o Main Switchboard o Distribution Boards o Group Starter panels o Battery chargers o Starters	431 to 433	3	2013
L&T Shipbuilding	Interceptor Boats for Indian Coast Guard	o Main Switchboard o Distribution Boards o Group Starter panels o Battery chargers o Addressable Fire Detection System o Flood detection system o Consoles o General Alarm System o Tank Gauging system	35001 to 350036 & 36001 to 36018	54	Delivered for first twenty six ships since 2011 to 2014
Temba	10T Tug for Indian Navy	o Main Switchboard o Distribution Boards o Group Starter panels o Battery chargers o Galley equipments o Consoles o Communication equipment	145 to 150	6	2011 to 2013
Hindustan Shipyard Limited	Fleet Support Vessel	o Main Switchboard o Distribution Boards o Group Starter panels o Battery chargers o Integrated Platform Management System	11184	1	Supply still to commence
Indian Navy	SNF Class	o Addressable Fire Detection System o Helo Starting Rectifier	-	4	2014

Major orders
Naval Switchboards & Control Systems

Customer	Type of Vessel/Owner	Scope of supply in brief	Yard/ Hull No.	No. of Vessels	Year of Supply
Temba	25T Tug for Indian Navy	o Main Switchboard o Distribution Boards o Group Starter panels o Battery chargers o Consoles o Galley equipment o Communication equipment	151 to 154	4	2012 to 2013
Modest Infrastructure	500T Fuel Barge for Indian Navy	o Main Switchboard o Group Starter Panels o Distribution Boards & Starters o Cables & accessories o SRE system, Engineers call system, AFDS o Luminaries o Alarm monitoring system	316 to 322	7	2011 - 2013
Indian Navy	P25	o Main Switchboard o Power Management System o Distribution Boards o Changeover Switches o Transformers	-	4	2013
Mazgaon Dock Limited	Destroyers (P15B) for Indian Navy	o Degaussing System o Main Switchboard o Energy Distribution Centers o DA Local Control Panel o Automated Power Management System o Integrated Platform Management System	12704 to 12707	4	Supply still to commence
ABG Shipyard	Cadet Training Ship for Indian Navy	Turnkey Electrical Package including: o Main & Emergency Switchboard o Group Starter Panels o Distribution Boards o Helo Starting rectifiers o Integrated Platform Management System o Integrated Bridge System	397, 398 & 423	3	Supply still to commence
Garden Reach Shipbuilders & Engineers Ltd.	Landing Craft Utility for Indian Navy	o Integrated Platform Management System	2092 to 2099	8	First shipset delivered in Aug 2014
Pipavav Defence Offshore and Engineering Co. Ltd.	Naval Offshore Patrol Vessels for Indian Navy	o Main & Emergency Switchboard o Energy Distribution Centers o Navigation Light Control Panel o Starters	001 to 005	5	Supply still to commence

Major Orders
Commercial Switchboards & Control Systems

Customer	Type of Vessel/Owner	Scope of supply in brief	Yard/ Hull No.	No. of Vessels	Year of Supply
Converteam UK Ltd./EZRA Marine, Singapore	Flexible Pipelay Vessel Lewak Crusader (134m)	o 690V Main Switchboard o 440V Main Switchboards o 220V Main Switchboards o 440V & 220CV Emergency Switchboards o 440V, 220V AC & 24V DC DBs o Distribution Transformers o Starters (DOL & Soft)	602	1	2009
ABG Shipyard/Tanker Pacific, Singapore	80T Anchor Handling Tug	o Main Switchboard o Emergency Switchboard o Group Starter Panels o Distribution Boards (AC & DC) o Navigation Lighting Panel o Distribution Transformers o Alarm Monitoring System	327 328	2	2009
L&T Shipyard/Rolldock, Netherlands	RoRo LoLo Ships	o Main Switchboard o Emergency Switchboard o Group Starter Panels o Distribution Boards (AC & DC) o Navigation Lighting Panel o Shore Supply Box	81001 81002 81003	3	2009
Greatship Global Offshore Services Pte Ltd., Sinagapore	Multirole & ROV Support Vessel	o 690V Main Switchboard o 1050kW Soft starters	314 - 344	4	2009
	Multi-Purpose Survey Vessels	o 690V Main Switchboard o 1050kW Soft starters	26775 26784	2	2009
L&T Shipyard/ Big Lift, Netherlands	Big Lift Cargo Vessel	o Main Switchboard o Emergency Switchboard o Group Starter Panels o Distribution Boards (AC & DC) o Navigation Lighting Panel o Distribution Transformers o TRUs o Alarm Monitoring System	81007	1	2011
ABG Shipyard/ Vardha Marine, Norway	130T BP Anchor Handling Tug	o Alarm Monitoring System	343, 344 & 354, 355	4	Delivered for two ships in 2011
ABG Shipyard/ Marnavi, Italy	130T BP Anchor Handling Tug	o Switchboards/Electricals	355	1	2012
Punj Lloyd	Mahesh 1 Barge	o Main Switchboard	-	1	2012
Hindustan Shipyard Limited / Kandla Port Trust	50T BP Tug	o Main Switchboard o Distribution Boards o Starters	11173 & 11174	2	Supply still to commence

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L&T Electrical & Automation

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