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Marine Electrical Equipment Made for Hyperbaric Ambiences

The Institute of Marine Engineers (India)

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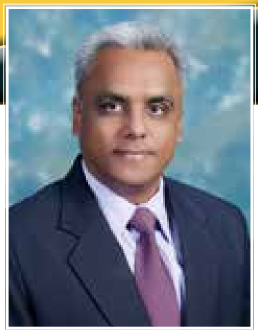

Now and then we had the hope that if we lived and were good, God would permit us to be pirates. – Mark Twain

In the recent sitting of MEPC 81, a significant discussion brief is from the International Association of Ports & Harbours (IAPH) on strategizing with a 'basket of mid-term measures'. The technical and economic components under Global Fuel standard (GFS) and the GHG pricing mechanism provide significant guidance. The GFS will prescribe the upper limit of GHG intensity and lowering it in phases (with many candidate fuels in contention their life cycle GHG needs to be analysed); whereas the pricing mechanism will incentivise the industry to adopt measures and also invest in energy efficient systems etc. The brief Guide from IAPH is educative and worthy as a read.

And the Red Sea (RS) region still remains red hot... The sea adventures of today has the ingredients from history, with the pirates and extended wars in the open waters. The difference lies in the much-modern military ware, which raises the stakes. However, there is adventure for the asking. The recent piracy attack thwarted by the IN certainly instils hope in the minds of seafarers. During the period of this Operation Sankalp, IN had responded to almost 18 piracy incidents. The IN has over 5000 personnel and around 21 ships in deployment in the RS region. Around 450 ship days have gone by and double the time in air surveillance trying to spot and scuttle the piracy and the war attacks. Such timely intervention and aid may not be a manna that all merchant vessels could hope for all the time.

The industry is already feeling the pressure. With about 20 hijack attempts (since November 2022), the insurance rates for vessels crossing Suez Canal have spiked by over 35-40% and near about half the traffic has shifted south towards the Cape of GH. Adding to these are the container freight costs (increases of US$2000+).

The Somali pirates had got bolder with the Houthi attacks apparently. The attacks need not involve state-of-the-art, modern missiles. Interestingly, one drone recovered by IN was made of plywood and powered by 4S moped engine. The electronics, PCB etc., were also basic school stuff, as observed.

The IN CoS in his brief to the Press, drew the cost asymmetry that the drone might cost a few lakhs but the missile to blow it may cost crores! And importantly, there was appreciation for the Maritime Anti-Piracy Act of 2022, which has enabled much of the action the Navy had carried out.

Given all the war materials and the weariness of conflicts, the romance of eye patch, cutlass and the pirate's treasure, the romance of rogue pirates in the high seas might just remain in the classic literature only. It is better that conflicts are brought to swift conclusions rather than drooling for the adventures.

In this issue...

We feature another informative article on bringing up electrical equipment to be fit for use under hyperbaric conditions. Hyperbaric environment can involve high hydrostatic pressures, lower temperatures, darkness, soft seabed etc. Dr. Veda et al., explain the construction considerations and approaches to building electrical machineries and systems to withstand these. The explanations on pressure compensation, the testing technology developments on the Indian side are interesting takeaways. The tests and discussions on circuit breakers, lead acid batteries and induction motors will be of interest to engineers. This is another educative read.

Next, we look at a paper presented at one of the recent Conferences on Coastal Communities and Marine Pollution. Ca. Kapildev Bahl presents a case with what could be another means for livelihood, the seaweed cultivation. Apparently, seaweed has applications in cosmetics, food, beverages, pharmaceuticals, crop yields, animal feedstock, textile industry etc. The article highlights a few schemes that can extend support to communities who could be made aware of the benefits of such schemes and also trained for adopting to seaweed cultivation. A few technical aspects of this weed cultivation and support models are also discussed. A discussion on how the Government's policy may be aligned to help the issue is also extended. This is an easy read.

The Competency Corner has Elstan Fernandes with ways to troubleshoot alternator problems. The MER Archives of April 1984 has a few good value additions which would relate with engineers from the eighties-era. Under Heritage Hourglass, Janhavi Lokegaonkar traces the naming tradition of Indian Naval ships.

While we start the colourful celebrations of Holi and our democracy, here is the April 2024 issue for your reading pleasure. And the GMIS referred to in the last Editorial was for the year 2023 and not as mentioned, in case your discerning eyes had missed that.

Dr Rajoo Balaji
Honorary Editor
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Characterizing the Performance of Electrical Systems under Hyperbaric Conditions

N.Vedachalam, A. Umapathy, B.O.Vishwanath

Abstract

Pressure Tolerant Electric (PTE) refers to electrical and electronic components or systems developed or modified so that they can satisfactorily operate in hyperbaric environments without the need for pressure-rated enclosures, electrical and optical connector/penetrator requirements. Hence more-reliable and less-complex PTE configuration is attractive for subsea vehicles and long-term deployments as it mitigates flooding and implosion risks, reduced inspection and maintenance requirements. Carrying out experiments to understand the influence of hydrostatic pressures on their construction, packaging and operating principles are essential for adopting them to reliably meet the envisaged functional requirements. The article describes the principles of pressure compensation, global developments in PTE hitherto and the outcome of the experiments carried out in National Institute of Ocean Technology (NIOT) for characterising the performance of oil circuit breakers, lead-acid batteries and induction motors under hyperbaric conditions.

INTRODUCTION

Oceans with an estimated asset value of US$ 24 trillion are a promising strategic frontier for economic growth, water and food security. The technologies used for the exploration and harvesting the vast blue economic living and non-living resources in the challenging deep oceans are to be reliable, compact and efficient.

Pressure Compensation (PC), is a technique based on the principle of maintaining the system internal pressure near equal to that of the external sea water ambient hydrostatic pressure using hydraulic pressure compensating systems. This helps to eliminate the need for thick-walled metal enclosures, avoid pressure-rated feed-through, reduce thermal challenges and other associated complexities. **Pressure Tolerant Electronics (PTE) refers to the electronic components or systems developed or modified so that they can satisfactorily operate in a hyperbaric environment without the need**

Pressure Compensation (PC), is a technique based on the principle of maintaining the system internal pressure near equal to that of the external sea water ambient hydrostatic pressure using hydraulic pressure compensating systems

for pressure-rated enclosures and feed-through. The guidelines released by the United States Naval Ship Research and Development Centre (US-NSDRC) in early 70s pertaining to the design and maintenance of the deep-ocean PC systems have paved the way for developing compact subsea mechanical and electrical systems. The paper discusses the global developments in PTE till date, and presents the observations of the experiments carried out on industry-standard oil circuit breaker, lead-acid battery and asynchronous induction motors for characterising their performance under hyperbaric conditions.

Pressure compensation (PC) is a technique applied to subsea systems to eliminate the need for thick-walled enclosures, feed through and associated complexities

Understanding Pressure-compensation

The demanding deep-ocean environment and the associated technical challenges are mapped in **Figure. 1.** The hydrostatic pressure in the oceans increases linearly at the rate of ~ 1 kg/cm^2 every 10m of water depth. When a system is to be operated in a high-pressure hydrostatic environment, it must be protected inside enclosures that can withstand the external pressure and saline sea water. The thickness of the enclosure (normally cylindrical with hemispherical end domes) depends on the external pressure and the material

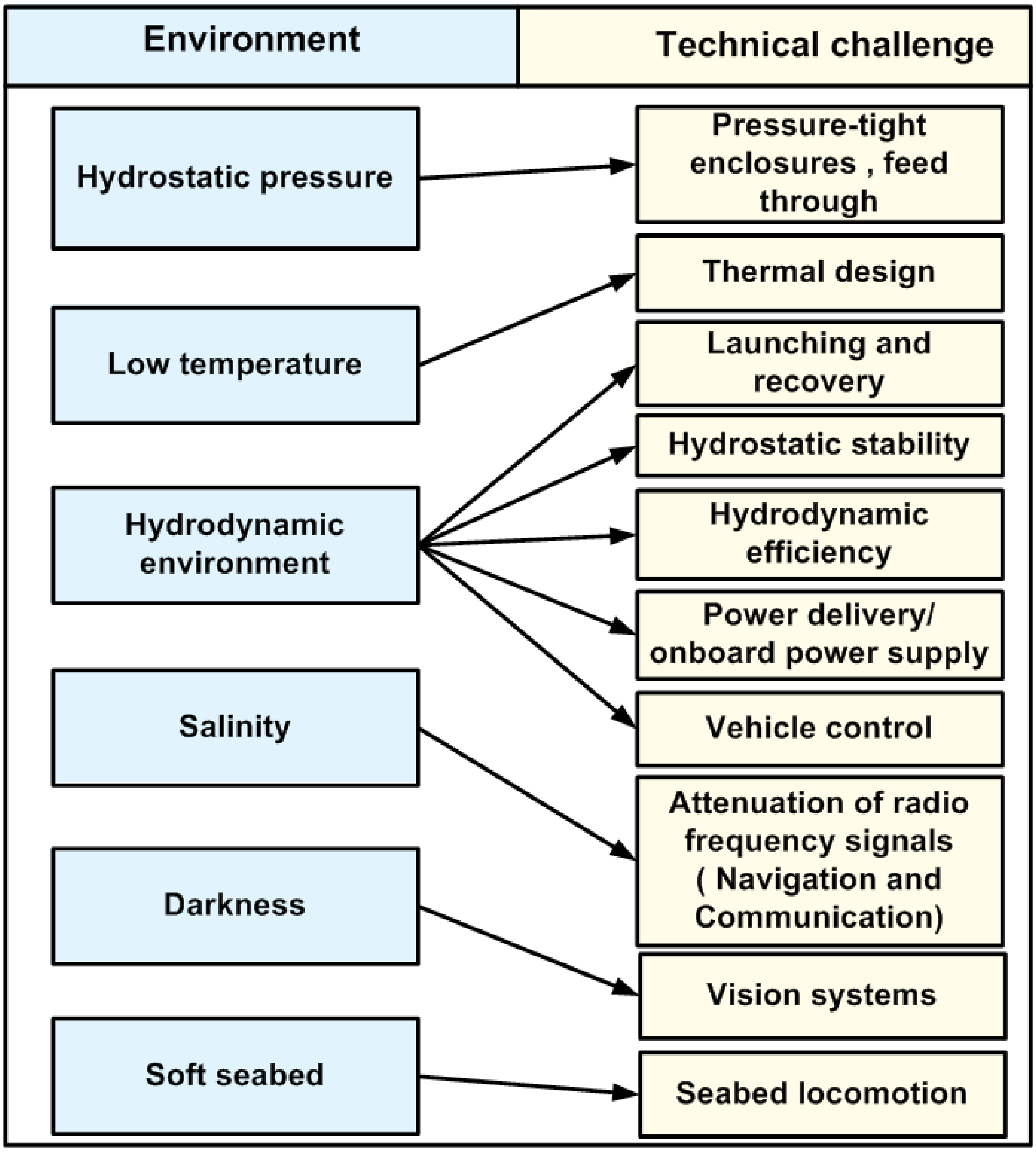

Figure. 1. Environmental challenges and design consideration

of construction of the enclosure. When the enclosure diameter increases, the wall thickness must increase to avoid failures due to buckling.

Electrical and electronics systems that are operated inside these enclosures must communicate with the other external systems via pressure-rated feedthrough, such as penetrators and connectors. The cost, the weight and the complexity of the feed through components increase with the differential pressure.

The longitudinal and the circumferential stresses acting on the cylindrical enclosures are,

$$\text{Longitudinal stress} = \frac{qR}{t}$$

$$\text{Cirumfrencial stress} = \frac{qR}{2\,t}$$

where q is the unit pressure, R is the radius of curvature of the circumference and t is thickness of the enclosure.

The thickness of these enclosures should be sufficient to overcome these axial and circumferential stresses caused by the external hydrostatic pressures. The design of the pressure-rated enclosures should consider the operating ambient temperature variations, shape, dimensions and weight limitations, material of construction, fabrication properties, creep properties under external hydrostatic pressure, cyclic pressurising effects, collapse strength, elastic-plastic behaviour, internal heat dissipation requirements, corrosion allowance and safety factor.

The stress and the buckling analysis are performed by analytical and numerical methods considering the design requirements and the compliance needs of statutory agencies. The enclosure used for housing power electronic and electronics systems in a 6000m depth rated underwater system is shown in **Figure. 2**

Pressure compensation (PC) is a technique applied to subsea systems to eliminate the need for thick-walled enclosures, feed through and associated complexities. The technique involves the principle of maintaining the internal pressure equal to the external ambient hydrostatic pressure, which is achieved with the use of oil medium pressure compensators, which will be connected hydraulically to the system. The compensator consists of a piston, one side of which is exposed to the ambient pressure, with the other side directly connected to the oil-filled housing **(Figure. 3).**

Figure. 2. 6000m depth-rated enclosure housing electronics

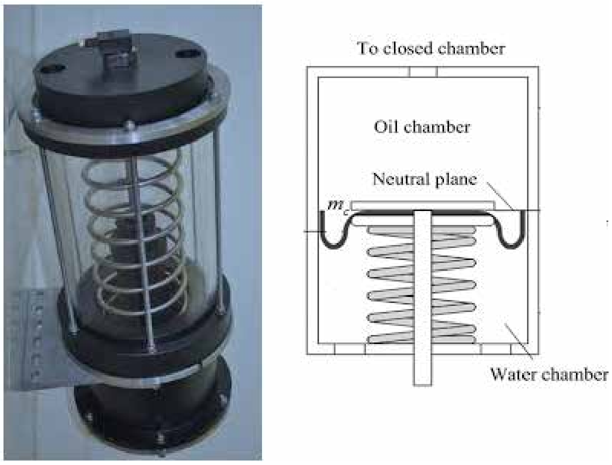

Figure. 3. Principle of a subsea pressure compensator

The spring provides additional force against the piston, resulting in the pressure inside the housing being slightly higher than ambient. This simple feature ensures that in the event of a leak, oil will flow out of the housing, instead of seawater flowing into it. As an example, if the internal volume to be compensated is 50L with an oil having a compressibility factor of 0.9615 and a thermal coefficient of expansion of 0.00075/°C, taking into consideration the change in volume of the oil (resulting for change in pressure and temperatures for the surface and subsurface conditions), a pressure compensator with reserve capacity of 1.5L capacity is required. Even though PC helps to reduce the thickness of the enclosure, the systems/components inside the PC enclosure experiences the hydrostatic pressure prevailing at that water depth. This demands development of PTE systems.

Developments in PTE and systems

The development of the 127mm dia-500mm long portable hyperbaric system by the United States Naval Research Lab (NRL) in 1960 capable of characterising the behaviour of the electrical and electronic components up to 1000 bar marked the beginning of the PTE and PC system development era. During 1970's, the Scripps Institute of Oceanography (SIO) developed PC data telemetry, compass module and acoustic sensors suitable for operation up to 2300m water depths. During the same period SIO also developed 5.6 kW PC electric motors for operating Remotely Operable Vehicle (ROV) manipulators, and Digicourse developed a 6000m depth-rated PC compass. During 1970-2000, significant activities included development of hybrid electro-optic wet mate underwater connectors, studies on the behaviour of different families of resistors, transistor, diodes, capacitors and power contactors under hydrostatic pressures up to 700bar. It was reported that bulk carbon resistors showed a reduction in the resistances up to 30% at 700 bar and film resistors were found to be pressure-tolerant.

During 2000-10, developments were reported mainly in the field of batteries and power capacitors. The University of Southampton carried out hyperbaric tests on the Lithium-Polymer (Li-Po) cells up to 600 bar, the Japan Agency for Marine-earth Science and Technology (JAMSTEC) reported the development and use of PC Li-Ion batteries for their deep-water human-occupied submersible Shinkai6500, the US General Dynamics Mission Systems reported application of PC Li-Po batteries of 1.5 kWh capacity for their Autonomous Underwater Vehicles (AUV), and the PC valve regulated lead-acid batteries were introduced by the Deep Sea Power & Light company in the US. The SINTEF lab in Norway analysed the effects of the hydrostatic pressure on the capacitors used in the power conversion applications and the developed methods of pressure compensating them for use in hyperbaric environments. They also reported that the film capacitors were found to perform satisfactorily at high hydrostatic pressures. In order to cater to the subsea market, the US opto-electronics manufacturer Moog introduced commercial grade PT optical data multiplexers and transceivers.

After 2010, activities were reported on the development of PT power electronics, optical cables, oscillators, capacitors, power contactors and variable frequency power converters. SINTEF labs analysed the effects of hydrostatic pressure on the power semiconductors including Insulation Gate Bipolar transistors (IGBT) and its gate-driver electronics. It was identified that flooding the sulphur hexa-fluoride (SF_6) gas-filled spaces with suitable dielectric fluid could help realise a PT IGBT. SINTEF labs also analysed the hydrostatic pressure effects on the optical components and reported that the optical components are unaffected by the short-term exposure to hydrostatic pressure. An Iran-based telecom research centre published the results of the influence of hydrostatic pressure on the performance of fibre-optic cables with varying cladding material properties. The performance of the quartz-based crystal oscillator used in the ROV manipulator embedded electronics was analysed under hydrostatic pressure and was found that the oscillator output voltage amplitude reduced up to 60% at 600bar pressure.

In India's National Institute of Ocean Technology (NIOT) -developed deep-water electric work class ROV ROSUB 6000, low-voltage power contactor is used for opening and closing a 6.6 kV, 460 Hz power circuit in the tether management system under no-load conditions, using a mechanism involving control algorithms and super-capacitor-based energy storage, thus offering fault discrimination feature between the two-bodied under water system. In the 11000m depth-rated Deep-Sea Challenger (DSC) manned submersible, ceramic capacitors exposed to hydrostatic pressure were used in the power switching devices, and PC motor controllers of 10kW capacities were used to operate the propulsion

thrusters. The South-West Electronic Energy (SWE) Group reported development of the PC Li-Ion batteries for subsea applications.

Recent developments collated in **Figure. 4** include the 11km depth- rated PT Li-Ion battery used in DSC **(Figure. 4a),** PT electronics used in Sub-Atlantic ROV **(Figure. 4b),** subsea 3000m depth-rated medium voltage variable speed drive jointly developed by ABB, Equinor, Total and Chevron **(Figure. 4c),** PT Lithium Sulphur (Li-S) battery pack for Marine Autonomous Systems **(Figure. 4d)** as Li-S cells can withstand 100% discharge without damage and hence maintenance-free, world's largest diameter hyperbaric test facility at Krylov State Research Centre (KSRC), Russia **(Figure. 4e)** and the hyperbaric test facility (800bar) at James Fischer Defence (JFD) **(Figure. 4f).** Major (Top 5) hyperbaric facilities in the world, categorised in terms of maximum test pressure and internal diameter are summarised in **Table. 1.**

Circuit breakers

Advantages of PC oil circuit breakers

Circuit breakers are used for closing and opening the electrical circuits during normal and fault conditions. When the contacts of a circuit breaker (CB) are separated in a dielectric medium, the arc produced not only delays

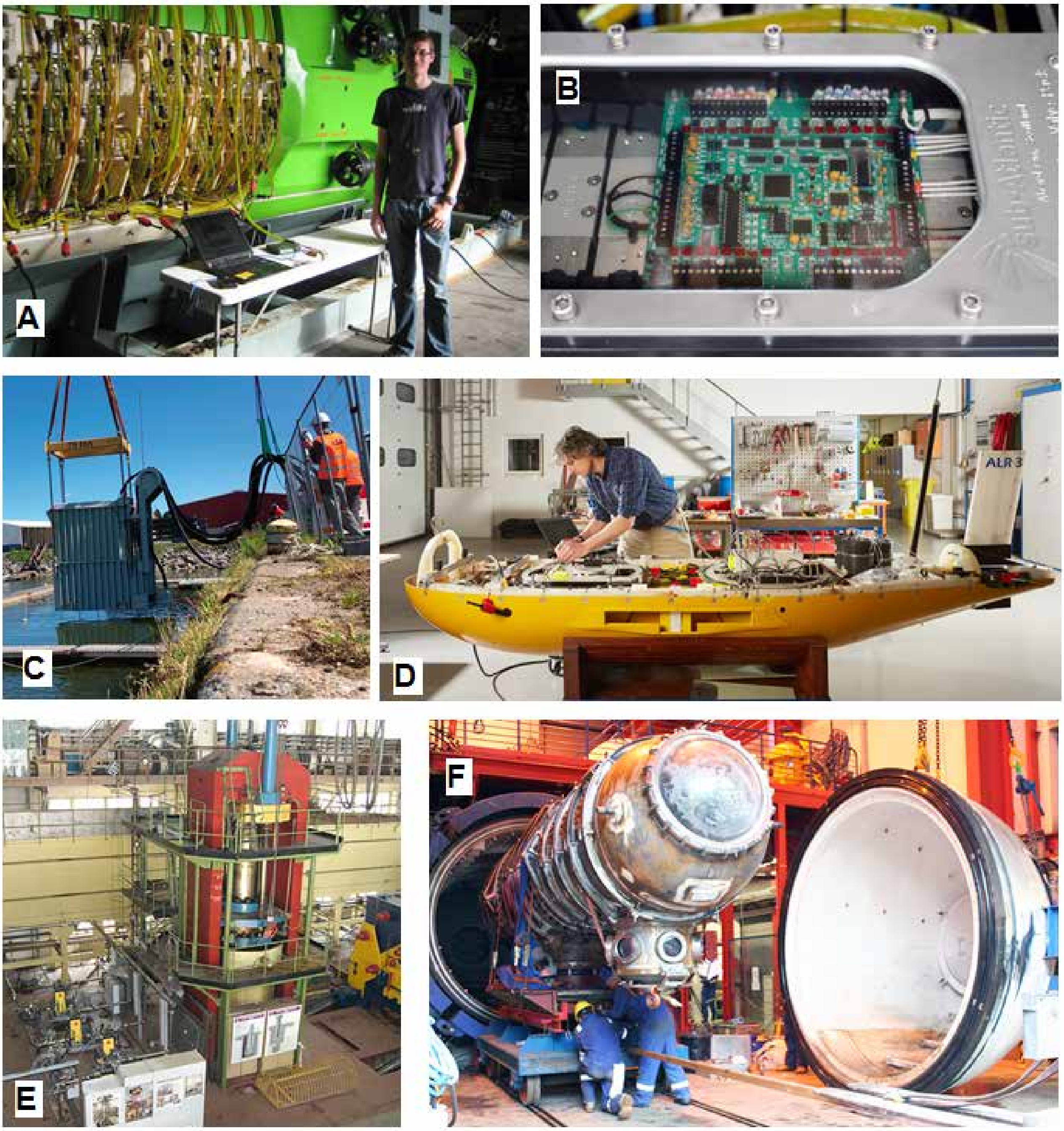

Figure. 4. Significant PTE developments and hyperbaric test facilities

Table. 1. Top 5 hyperbaric test facilities in the world

Pressure (bar)	Diameter & Length	Facility operator & Country
Based on Pressure		
2068	0.4m, 3.0m	SWRI, US
2000	0.8m, 2.5m	IDSSE, China
1800	2.8m, 5.0m	IDSSE, China
1800	0.6m, 3.0m	HAST, China
1600	1.6m, 3.0m	CSSRC, China
Based on Diameter		
Diameter	**Pressure & Length**	**Facility operator & Country**
3.2m	1000bar, 9.5m	Krylov, Russia
3.0 m	900bar, 6.2m	CSSRC, China
2.8m	1800bar, 5m	IDSSE, China
2.5m	1500bar, 7m	EPSI, Belgium
1.8m	1500bar, 5.5m	Krylov, Russia

the current interruption process but also generates heat. The heat energy dissipated by the electric arc is given by,

$$Earc = \int_{t1}^{t2} VIdt$$

where t_1 is the moment of galvanic coupling separation in ms, t_2 is the moment of arc extinguishing in milliseconds, V and I are the arc voltage and current. The heat produced in the medium ionises the particles which acts as a conductor, and an arc is produced between the contacts. The arc provides a low resistance path and consequently the current in the circuit remains uninterrupted so long as the arc persists. During the arcing period, the current flowing between the contacts depends upon the arc resistance which depends on degree of ionisation of the particles in the medium, length and cross section of the arc. Thus, selection of the CB for a specific application depends on the voltage and current to be interrupted, duration of the electric arc and the allowable heat generation. Based on the dielectric strength of the dielectric medium, circuit breakers are classified into air break, air blast, minimum oil, bulk oil, vacuum and sulphur-hexa-fluoride (SF_6) circuit breakers. The dielectric strength of air, mineral oil and SF_6 are 3, 10 and 60kV/mm respectively.

In an oil circuit breaker (OCB), when the separation of contacts just starts, the distance between the contacts is small and the voltage gradient is high. This high voltage gradient between the contacts ionizes the dielectric oil which initiates an electric arc between the fixed and the moving contacts. Depending upon the magnitude of current, the arc heats the surrounding dielectric oil. When the amount of heat increases the temperature of the oil above its boiling point, the dielectric oil vaporises and decomposes generating hydrogen and small amounts of methane, ethylene and acetylene, which forms as a gas bubble around the arc and grows in size. If this growing gas bubble around the arc is compressed by some means, then the rate of deionisation of the ionised gaseous media in between the contacts will accelerate rapidly increasing the dielectric strength between the contacts and favours quenching of the arc **(Figure. 5).** Arcing also produces organic particles such as carbon fines and larger conglomerations due to the breakdown of the dielectric oil. This results in the degradation of the oil which requires reconditioning or replacement after definite operating cycles.

When the contacts of an OCB is opened under pressure in a PC system, the higher ambient hydrostatic pressure of the surrounding oil compresses the hydrogen gas around the arc, thus deionising of the gas and quenching the arc early. This greatly increases the rate at which the arc gases are replaced by surrounding dielectric medium. As this raises the dielectric strength of the arc path, the breaking capacity of the OCB is expected to increase multi-fold.

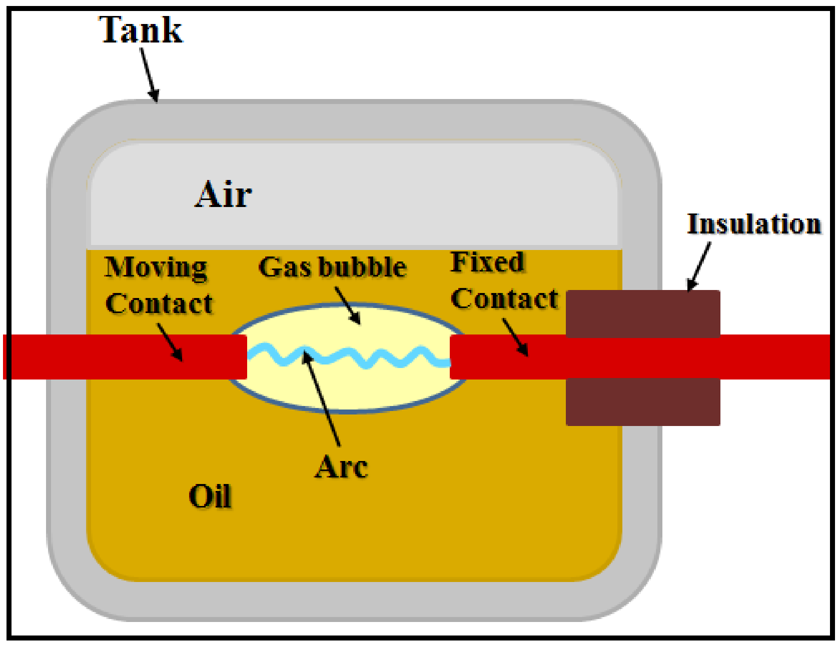

Figure. 5. Principle of circuit opening in dielectric oil medium

Hyperbaric experiments-Materials & Methods

The methodology adopted for experimentally determining the influence of the higher hydrostatic pressure on the performance of the PC electro-magnetically operated electric contactor is shown in Fig.6. The hyperbaric test facility in NIOT, a unique facility in South Asia, is used for carrying out the experiments. The Engineering Pressure Systems International (EPSI) make, 150 mm

When the transformer oil is subjected to hyperbaric conditions, the kinematic viscosity of the oil increases

thick walled hyperbaric chamber made of SA 723 Grade 3 Class 2 material, has an effective internal diameter of 1m and length of 3m. The system produces hydrostatic pressures up to 900 bar using water as the pressurising medium at ambient temperature conditions. The system operation is controlled by a programmable control system in which the desired pressure profiles could be programmed. During the entire testing cycle, the control system continuously monitors the system pressure, and when a sudden drop in pressure is experienced due to the failures or degradations in the equipment-under-test (EUT), the applied test pressure is released automatically. The electrical and the fibre optical feed-through provided in the hyperbaric chamber top flange enables online electrical and optical interface with the EUT under pressurised conditions.

The EUT comprises of a 300V DC, 30A, 3 pole power contactors kept inside transformer oil-filled PC metallic enclosure. The transformer oil serves as an insulation medium as well as a PC fluid inside the EUT (Insulating Mineral oil, Viscosity grade: VG12 at 40°C). The PC with the external water medium is achieved using a 500ml rolling diaphragm type pressure compensator **(Figure. 6, 7).**

One of the poles of the contactor (Siemens, Model: 3TC44, coil voltage 240V, 50Hz, voltage rating: 300VDC, current rating: 30A) is connected to the external electrical loading system through the hyperbaric chamber electrical feed-through so that the contactor could be electrically operated under pressure. The 24V control command to the contactor operating coil is also provided from the penetrator feed-through. A 24V, 100 W resistive heating element is also provided inside the EUT so that the temperature of the PC transformer oil could be increased during the hyperbaric tests. An RTD type temperature sensor is used to monitor the transformer oil temperature. The power to the heating element and the leads of the RTD are interfaced through the hyperbaric flange penetrator feedthrough. The arc current is measured using a current probe and the oscilloscope.

When the transformer oil is subjected to hyperbaric conditions, the kinematic viscosity of the oil increases. When the moving contacts of the power contactor is actuated in the hyperbaric oil environment, the force required to close and open the moving contacts also increases with the increasing viscosity, compared to operating in normal ambient pressure conditions. If the

Figure. 6. View of hyperbaric testing of CB

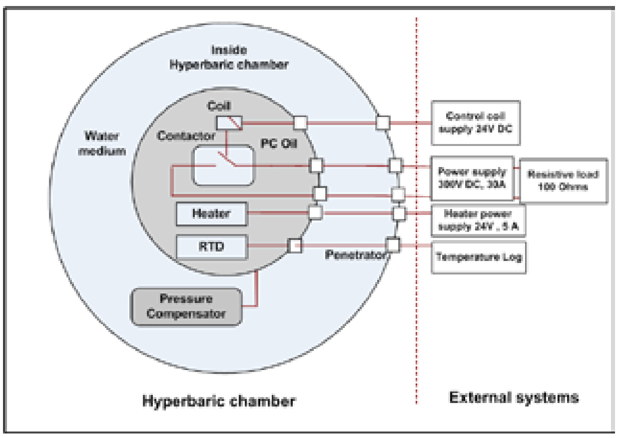

Figure. 7. Testing methodology for hyperbaric performance

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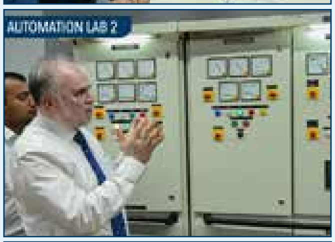
2.	Practical Marine Electrical (Advance) - Module 2	22-24, 29-02 May	20-22
3.	Electronics for Marine Engineers - Module 4	01-02, 25-26	06-07, 23-24
4.	Instrumentation, Process Control & Programmable Logic Controllers - Module 5 & 6	-	13-17, 27-31
5.	Auxiliary Diesel Engine and Maintenance Course	01-05, 15-19, 22-26	06-10, 13-17, 27-31
6.	Bridge Manouervering & Engine Control - Management Level	29-02	27-29
7.	Bridge Manouervering & Engine Control - Operational Level	04-05	09-10
8.	Hydraulics for Engineers - Basic	01-03	06-08
9.	Hydraulics for Engineers - Advanced	15-19	13-17
10.	Maritime Crew Resource Management (MCRM)- CAE Accredited	01-04, 22-25, 29-03	06-09, 20-23
11.	Machinery Breakdown Safety Campaign - 1	05, 26	10, 24
12.	Machinery Breakdown Safety Campaign - 2	19	17, 31
13.	Machinery Maintenance - Skill Enhancement - Module 2	01-05, 15-19, 22-26	06-10, 13-17, 20-24, 27-31
14.	Machinery Maintenance - Skill Enhancement - Module 3	15-18, 29-03	13-16, 27-30
15.	Machinery Maintenance - Skill Enhancement - Module 4	01-03, 22-24	06-08, 20-22
16.	Maritime Safety Management - Module 1 (Occupational & Behaviour Based Safety)	10-12	15-17, 29-31
17.	Maritime Safety Management - Module 2 (Risk Assessment)	10	06
18.	Maritime Safety Management - Module 3 (Shipboard Safety Officers)	11	07
19.	Maritime Safety Management - Module 4 (Accident Investigation)	12	08



VACANCY Faculty position | Training – Engineering

Qualifications and Experience

- Marine Engineer Officer Class 1 – COC from India / UK.
- With min. 1 year rank experience as Chief Engineer (Preference for experience on LNG/ LPG/ Tanker vessels).
- Experience in Ship operation, ship repair, teaching, auditing, inspections preferred.
- Training for Trainers and Assessors (TOTA) or Vertical Integration Course for Trainers (VICT).
- Other ISO / ISM / Technical Value-added courses. Excellent verbal and written communication skills.
- Should be interested in modern teaching methodologies.
- Candidate must have a passion for learning continuously and a desire to be in the teaching profession.
- Proficient in use of computers and savvy with use of various software.

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contactors coil closing actuator power and opening spring power are insufficient to overcome the increased oil drag, the power contact close/open duration increases leading to increased arcing and oil deterioration. Hence the temperature of the transformer oil was increased to offset the pressure-induced viscosity increase, accordingly the heater capacity was determined **(Table 2, 3).** Thus, the contactor is operated in a Constant Viscosity Condition (CVC), the data obtained from the transformer oil manufacturer's datasheets.

Thus, the increase in the temperature of the transformer oil by 25ºC above the ambient temperature of 35ºC shall help to offset the pressure-induced kinematic viscosity till 150bar, operating in the CVC region. It is experimentally determined that an electric heater of 40W is sufficient for increasing the temperature of the transformer oil inside the EUT from 35ºC to 60ºC in a period of 20 minutes.

Observations and discussion

Using the described EUT arrangement inside the hyperbaric system, the electric circuit breaking parameters of the power contactor for a load current of 10A at 300VDC is measured from ambient to higher pressure conditions. During the contactor opening, the current waveform under 1 bar and ambient temperature of 36º C is shown in **Figure. 8.** The second trace, which is zoomed section in the first trace (Z3) shows that, after opening the current flow continues in the form of arc for a duration of 6.2ms. The arc energy during the period is 8.9W.

The current waveform when the contactor is opened under 100bar and at an ambient temperature of 50ºC (raised using the internal heater by 14º C) is observed. After opening the contacts, current flow continues in the form of arc only for 1.8 ms, under the same electrical load conditions. The current waveform when the contactor is opened under 200bar and a temperature of 50ºC is shown in **Figure. 9.** The second trace, which is zoomed section in the first trace (Z3), shows after opening the current flow continues in the form of arc only for 0.8ms, under the under the same electrical load conditions. However, it was noticed that after 100ms, without the closing command, the electric circuit flow resumes in a period 150ms.

When the hyperbaric system is depressurised and when the contacts are inspected, carbon fines and larger conglomerations due to the breakdown of the dielectric oil were found **(Figure. 10)** between the contacts, when is the reason for the re-closure of the electric circuit. **This indicates that the increased oil viscosity has led to the increase in the circuit opening duration leading to arcing and degradation.** However, increasing the oil temperature above further above 50ºC could not compensate for the increased pressure-induced viscosity increase.

The measured circuit opening duration from 1 to 200bar is plotted in **Figure. 11.** It is identified that the circuit breaking duration and arc energy reduces 5-fold and 3-fold at 150 bars, respectively, compared to its performance at 1 bar. Above 200bar pressure, the increase

Table. 2. Change in kinematic viscosity with increasing pressure

Pressure (bar)	Viscous power (W)	% increase in kinematic viscosity
0	507	0
100	650	30
150	804	65
200	1023	100
300	1305	160
400	1612	220

Table. 3. Change in kinematic viscosity with temperature

Temperature	Kinematic viscosity (mm²/s)	% decrease in kinematic viscosity
35	38	0
40	30	21
50	18	53
60	10	64
70	9	76

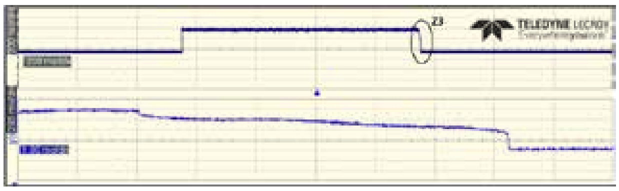

Figure. 8. Current waveform at 1 bar pressure condition

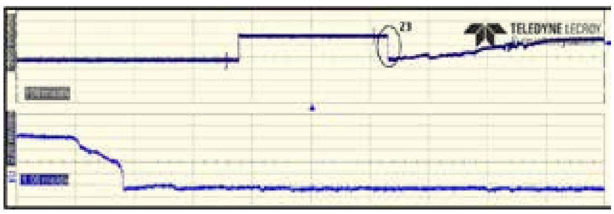

Figure. 9. Current waveform at 200 bar pressure condition

Figure. 10. Carbon particles bridging the contactor contacts

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RANKED GRADE A1 (OUTSTANDING)

D. G. Shipping Approved Course

05 Days

Course Id - 5121

Basic Training for Liquefied Gas Tanker Cargo Operations

Entry Criteria: Any seafarer who has successfully completed approved Basic Safety Training Course as per STCW Section A-VI/1, para 2.3, Tables A-VI/1-1, A-VI/1-2, A – VI/1-3, A-VI/1-4

- This Course will familiarize with the equipment, instrumentation and controls used for cargo handling on a Gas tanker. It will enhance the awareness to apply proper and safe procedures at all times when carrying out the various operations on board tanker

- The trainee will be able to identify operational problems and assist in solving them and will be able to co-ordinate actions during emergencies and follow safety practices and protect the marine environment.

Course Date: 27th to 31st May 2024

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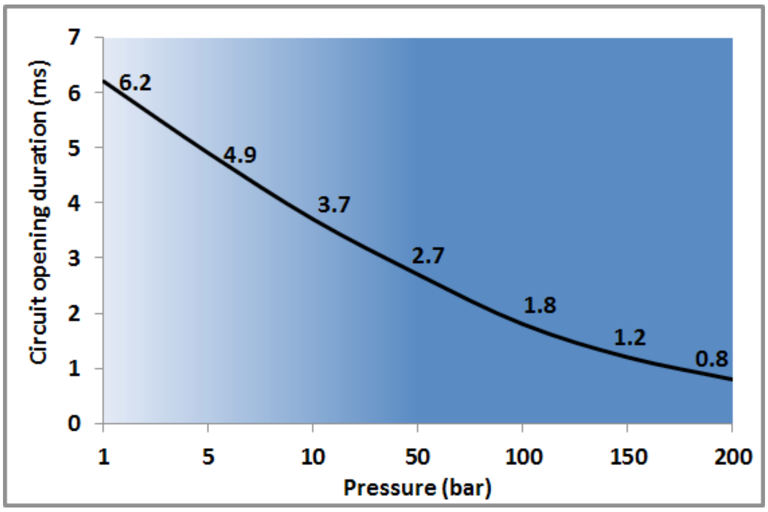

Figure. 11. Circuit breaking duration up to 200 bar pressure

in the oil viscosity increases the circuit breaker opening duration leading to arcing and formation larger carbon conglomerations due to the breakdown of the dielectric oil. The experimental observations thus reveal that power contactors could be used for circuit breaking operation in a PC mode up to 150bar pressure. The rapid opening helps to protect the downstream power system by reducing the let-through energy and reduce the oil degradation due to the heat generated by the arc. At hydrostatic pressures above 150bar, the electromagnetic contactor closing and opening mechanisms needs to be redesigned taking into consideration the viscosity change and the pressure compensating oil properties.

Lead-acid batteries

In the offshore sector, in view of its ruggedness and reliability, Valve-Regulated Lead-Acid (VRLA) batteries are employed. They are used in submarines, back-up power for the deep-water ROV control systems, remotely-operated tools and for powering the remote-located offshore oceanographic platforms. During 2009, the absorbent glass mat AGM-VRLA batteries were adopted for deep-ocean use by applying PC to the batteries. The PC involved filling the space above the plates and the electrolyte with adequate inert mineral oil providing compensation for the effects due to ambient pressure variations, thus eliminating the need for thick pressure-rated enclosures for housing the batteries. However, the performance of the PC-AGM-VRLA battery under higher hydrostatic pressure needs to be determined so as to apply appropriate de-rating factors based on the depth of operation and ambient temperature. The discharge performance of these batteries under various temperatures conditions are normally provided by the battery manufacturers. But the discharge performances of the batteries under hyperbaric conditions are not provided.

Hyperbaric experiments - Materials & Methods

The methodology adopted for experimentally determining the influence of the higher hydrostatic pressure on the performance of the PC-AGM-VRLA batteries is shown in **Figure. 12.**

The EUT comprises of a Power Sonic make PS-12400 model, 12V, 40AH AGM type VRLA battery kept inside dielectric oil- filled PC metallic enclosure. Shell Diala DX transformer dielectric insulating oil is used as PC fluid and pressure compensation is achieved using a rolling diaphragm type pressure compensator. The positive and the negative terminals of the battery are connected to the external electrical loading system through the

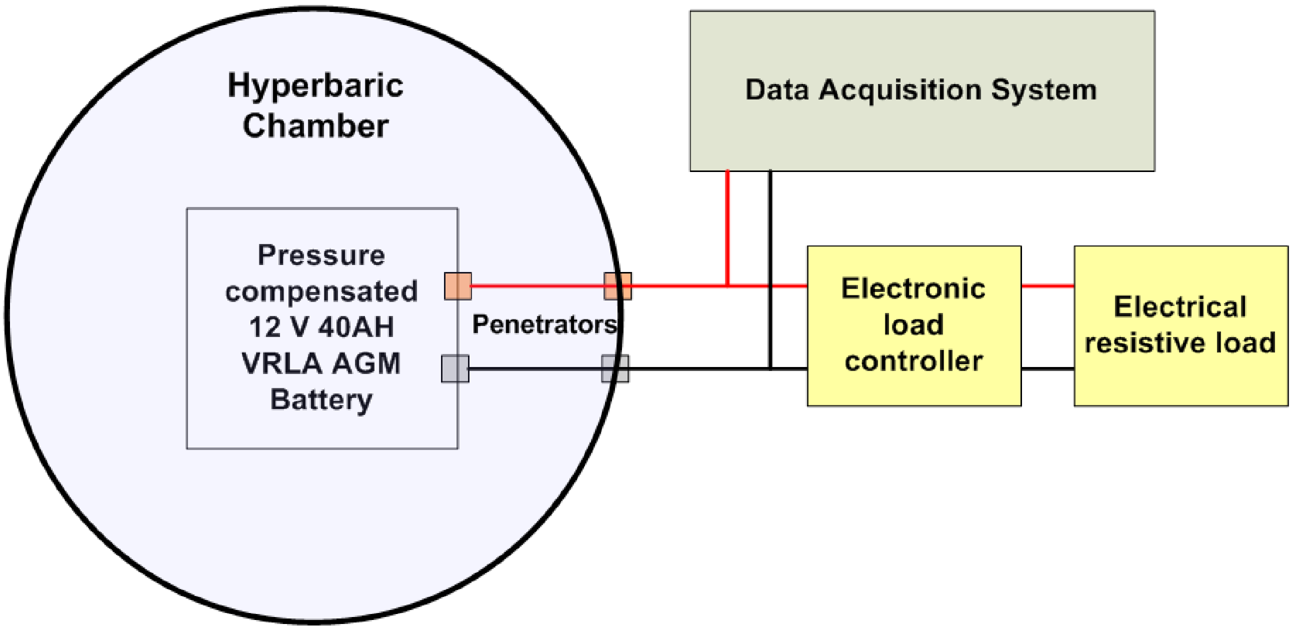

Figure. 12. Testing methodology for hyperbaric performance

In the offshore sector, in view of its ruggedness and reliability, Valve-Regulated Lead-Acid (VRLA) batteries are employed

hyperbaric chamber electrical feed-through so that the batteries can be electrically loaded under pressure. The discharge characteristics of the battery under various load currents (from 0.05C to 2C) are shown in **Figure. 13.**

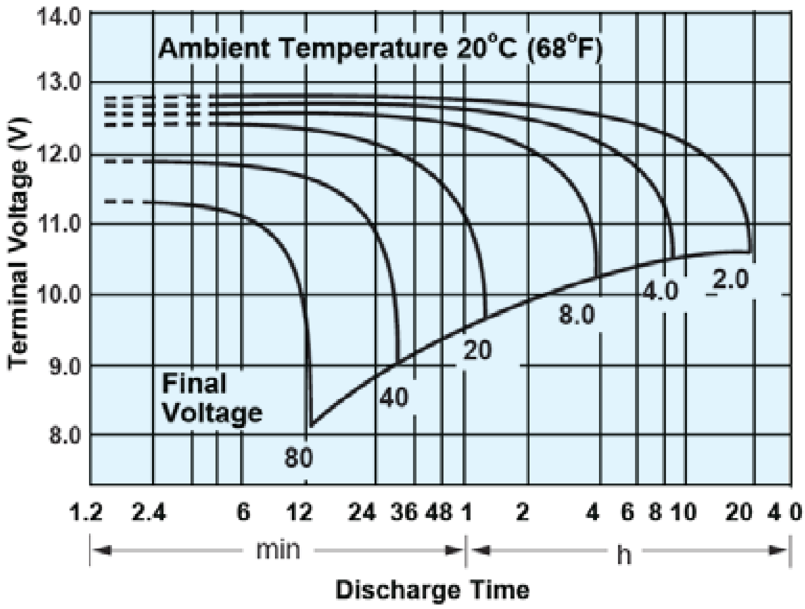

Figure. 13. VRLA battery discharge characteristics

The constant current loading system comprising of Agilent technologies make 6063B power electronics-controlled DC electronic loading system which could be programmed to provide a fixed value of load current independent of the battery terminal voltage was used. The data acquisition system used to log the battery voltage at 10 Hz frequency comprised of a National Instruments (NI) make Compact Field Point (CFP) 2220 real-time controller with 16-bit ADC analog channel programmed with LabView 8.6 Version 4 software. The data processing system is coded (below equation) to integrate the energy delivered by the battery with time.

$$E = I\int_{0}^{t} V dt$$

The PC-VRLA battery package being placed inside the hyperbaric chamber for testing under hyperbaric conditions, current loading and data-logging system are shown in **Figure. 14.** The test methodology included the comparison of the discharge performances (W-h) of the PC-AGM-VRLA battery at 0.25C under normal ambient pressure and 600 bar conditions. The experiments were carried out three times on three similar batteries.

Observations and discussion

Experiments were conducted for a 0.25C discharge profile under ambient conditions. Subsequently, with the EUT in place, the hyperbaric system pressure was increased at the rate of 20 bar/min and the plot of the same recorded by the control system is shown in **Figure. 15.** Once the system pressure reached 600 bar experiments were conducted for the same discharge profile.

The discharge performance of the battery under both 0.25C discharge condition observed under ambient pressure and at 600bar pressure are plotted in **Figure. 16.**

Figure. 14. Electrical loading and data acquisition system

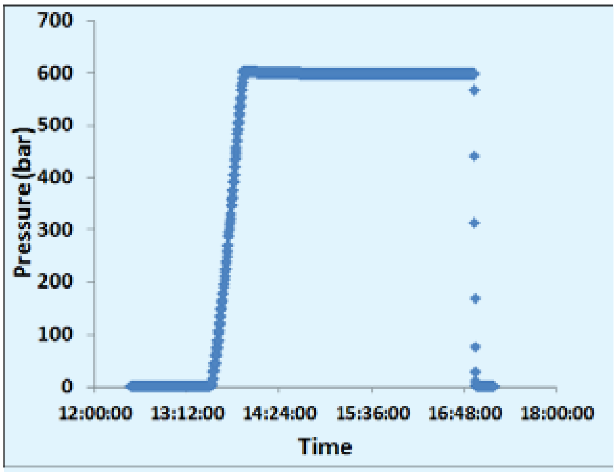

Figure. 15. EUT pressure profile recorded during the test

Under ambient pressure, the fully-charged battery with the terminal voltage of 12.5 V reduces to 11V after delivering a cumulative energy of 508 Wh in a period of 4.07h. But under 600bar pressure, for the same discharge profile, immediately on load the terminal voltage of the fully charged battery dropped to 11.35V. Subsequently, the battery cumulatively discharged 398 and 443Wh of energy till the terminal voltage reached 10V and 9.5 V respectively in 216 min (3.6h), and thereafter the voltage dropped rapidly. Even though the battery was drained below the recommended minimum voltage level of 10V, the energy delivery capacity of the battery under 600 bar pressure reduced by 13% compared with the same discharge profile under normal ambient conditions. The experiments are repeated three times using the same battery and similar experiments are done on three such batteries, and the energy delivery is found to vary in the range of 13±2%. Thus, there is a reduction in the energy capacity up to 15% and the terminal voltage by about 1.05 V for the pressure compensated AGM type lead acid battery when operated at 600bar pressure.

The consistency in the discharge performance under hyperbaric conditions needs to be confirmed after carrying out multiple pressure cycling tests so as to ascertain the energy delivery performance under long-term usage. Further, studies are being done for analysing the combined influence of the low temperature and higher hydrostatic pressure, the actual scenario in the deep-oceans.

Induction Motors

Deep-ocean located natural gas Enhanced Gas Recovery (EGR) compression stations, Enhanced Oil Recovery (EOR) pumps, water separation pumps, flow booster pumps used for cross country pumping, mineral mining machines and seabed conditioning dredgers are operated by high-capacity PC subsea motors. The viscous drag introduced by the PC oil under high pressure and low temperature conditions affects the subsea electric motor electrical performance. Experiments carried in the hyperbaric chamber to understand the increase in the motor starting power due to viscous drag provides insight on the motor capacity to be factored-in sizing the motors for such kinds of deep-ocean applications and protection coordination with the upstream power systems.

The influence of the pressure and temperature on the viscosity of mineral and synthetic oils measured using a high-pressure viscometer up to 8000bar and the correlation between the viscosity-pressure coefficient and the kinematic viscosity measured at atmospheric pressure was published in 2001. The influence of low temperature and high ambient pressure in the operational performance of PC brushless direct current (BLDC) motors are also published. A 10.7 kW BLDC motor reported increased motor losses including viscous and core loss together by 11% and 24% at 400 and 700 bars respectively. The core losses were found to increase by 13.6% and 27.3% under 400 and 700 bars respectively. Experimental studies carried out on a 12W BLDC motor filled with hydraulic oil 32, silicone oil of 50 cSt and 5 cSt grades, showed viscous drag power of 2.5, 3.5 and 0.5W respectively, at ambient conditions, significantly increased to 8, 7.5 and 1.6W respectively when subjected to pressure of 600 bar at 2ºC. However, such studies were not reported for three phase induction motors.

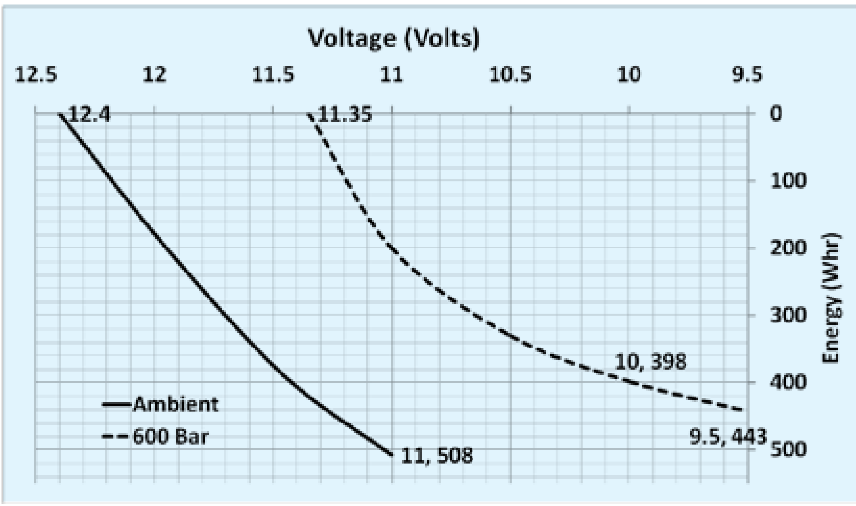

Figure. 16. Discharge performance under normal and pressure

Hyperbaric experiments-Materials & Methods

The methodology adopted for experimentally determining the influence of the higher hydrostatic pressure on the performance of the deep-sea motors is shown in **Figure. 17.**

Experiments were carried out in NIOT hyperbaric chamber with two sub-sea medium voltage induction motors 30 kW and 60 kW respectively. In both the motors hydraulic oil 32 is used as a PC fluid. The pressure compensators

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RANKED GRADE A1 (OUTSTANDING)

D. G. Shipping Approved Course

06 Days

Course Id - 5111

Basic Training for Oil and Chemical Tanker Cargo Operations

Entry Criteria: Any seafarer who has successfully completed approved Basic Safety Training Course as per STCW Section A-VI/1, para 2,3, Tables A-VI/1-1, A-VI/1-2, A – VI/1-3, A-VI/1-4

This course is principally intended for candidates for certification for basic training for oil and Chemical tanker cargo operations as specified in section A-V/1-1 para 1 of the STCW Code as amended.

On successful completion of this course, candidates will be qualified in accordance with regulation Section A-VI/1 of the STCW code for Seafarers, 1978 as amended and will be eligible to carry out the assigned specific duties and responsibilities related to cargo or cargo equipment on Oil and Chemical Tankers

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Course Date: 13th to 18th May 2024

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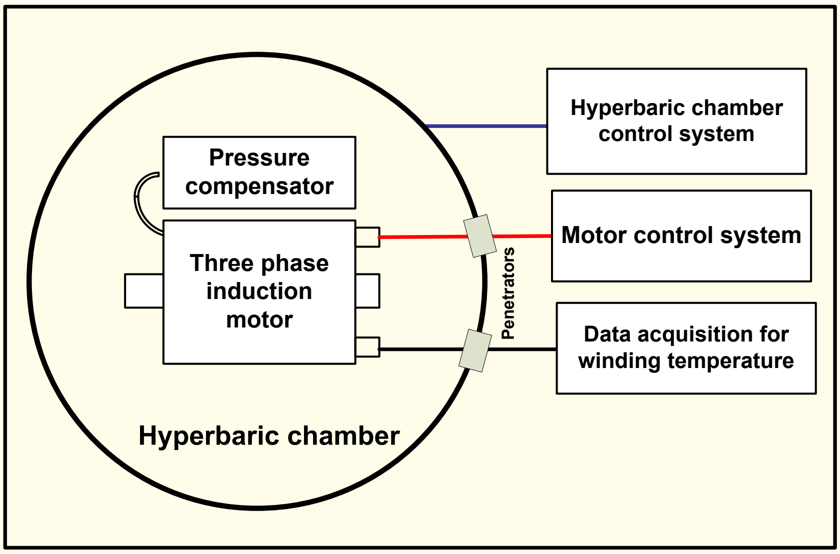


Figure. 17. Testing methodology for hyperbaric performance

Observations and discussion

The arrangement made for placing the subsea motors along with the pressure compensators inside hyperbaric chamber is shown in **Figure. 18.**

Figure. 18. Subsea motor placed in hyperbaric chamber

The pressure inside the hyperbaric chamber is increased in step of 100 bar up to 600 bar in a duration of 1 hour, and the power drawn by the subsea motors for overcoming the viscous oil drag at 35º C temperature are plotted in **Figure. 19.** The power excludes the no-load power of the motor which is measured in the absence of the PC oil. Under ambient pressure conditions the 30kW motor consumed a power of 500 W and increases to 2.5 kW at 600 bar. Likewise, the 60kW motor consumed a power of 2 kW and increased to 6 kW at 600 bar **(Figure. 19)** Thus the hydrostatic pressure increases the viscosity of the PC oil, which in turn increases the power required to overcome the increased viscous drag.

The motors under operation generate heat energy which is conducted to the PC fluid. This results in the increases in the temperature of the PC fluid leading to reduction in the viscosity and in turn the viscous drag power. The viscous drag power observed for motor winding temperatures up to 50ºC is plotted in **Figure. 20.** For the 30kW motor, the viscous drag power which was about 2 kW at 35º reduced to 1 kW at 50ºC, which is due to the reduction in the viscosity of the PC fluid at increased temperatures. Based on experimental observations in the 35-50ºC temperature range, the viscous drag power for lower temperatures are obtained through data extrapolation using MATLAB and the inferred results are plotted in the same **Figure. 20** using dotted lines. It is inferred that, without any connected shaft load, an industry standard 30kW PC subsea motor could require a starting power of 10 kW at 600 bar and 2ºC, compared to 0.5 kW at ambient conditions.

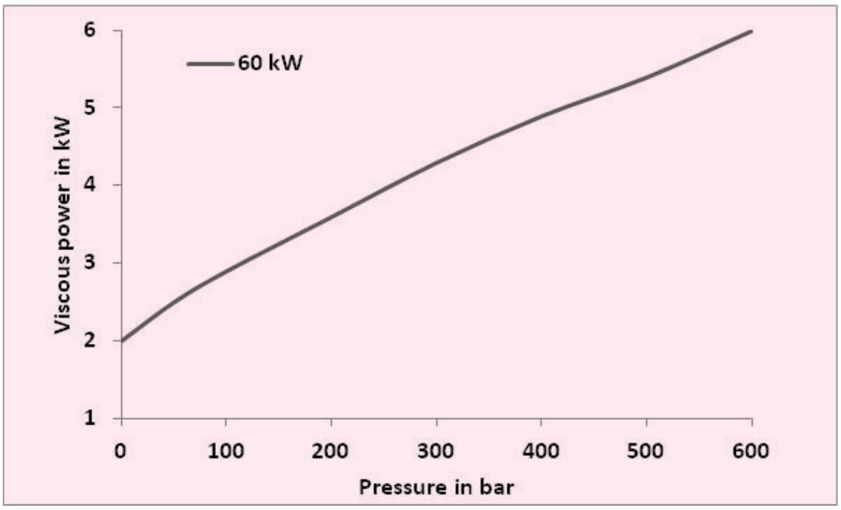
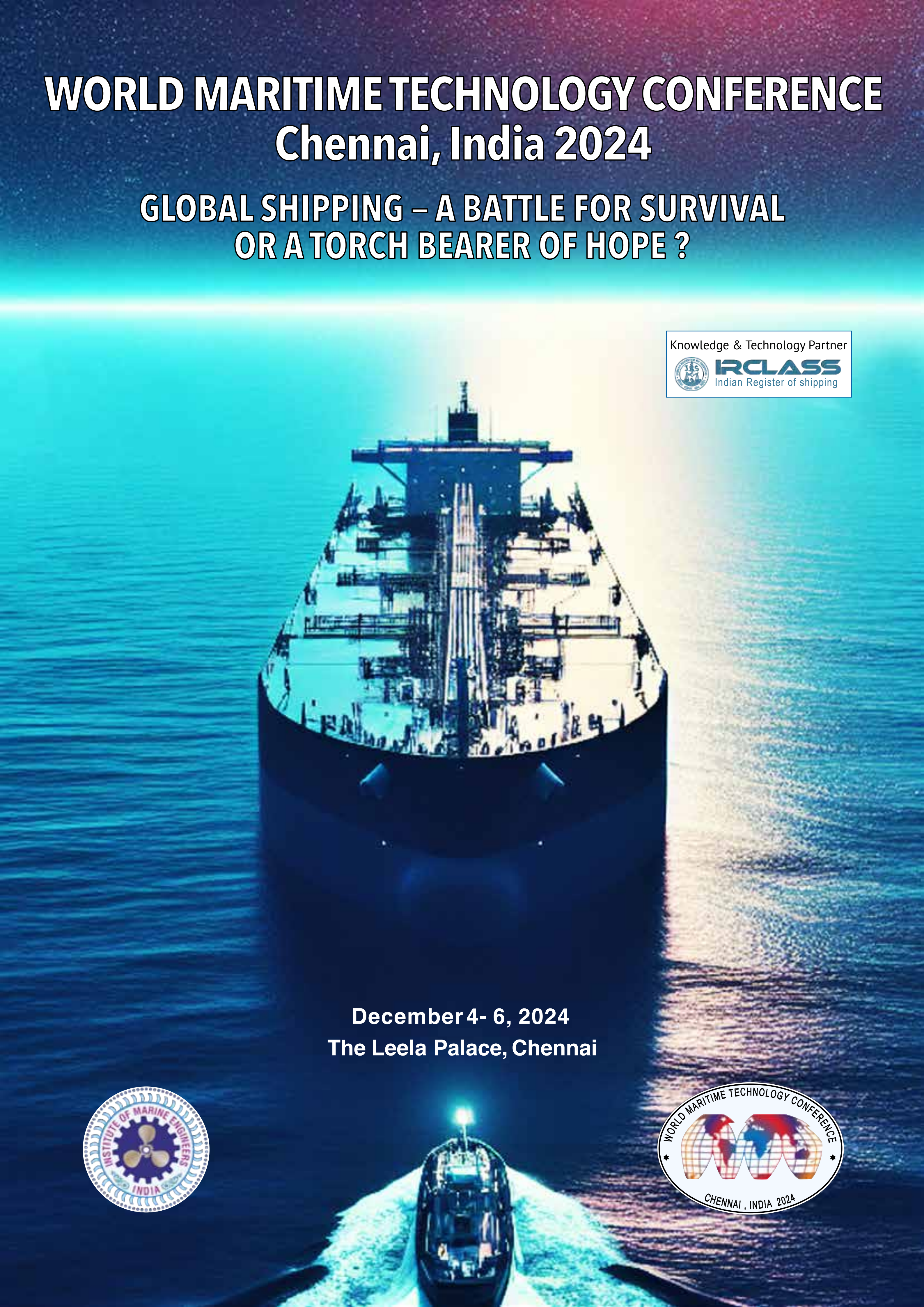


Figure. 19. Viscous power under increasing pressure at 35ºC

A	Amperes
ADC	Analog-to-Digital Converter
AGM	Absorbent Glass Mat
AUV	Autonomous Underwater Vehicles
BLDC	Brushless Direct Current
CB	Circuit Breaker
CFP	Compact Field Point
COTS	Commercial-off-the-shelf
CSSRC	China Ship Scientific Research Centre
CVC	Constant Viscosity Condition
DC	Direct Current
DSC	Deep Sea Challenger
EB	Electron Beam
EGR	Enhanced Gas Recovery
EOR	Enhanced Oil Recovery
EPSI	Engineering Pressure Systems International
EUT	Equipment-Under-Test
HAST	Hadal Science & Technology Research Centre
IDSSE	Institute of Deep-Sea Science & Engineering
IGBT	Insulation Gate Bipolar transistor

JAMSTEC	Japan Agency for Marine-earth Science and Technology
JFD	James Fischer Defence
KSRC	Krylov State Research Centre
Li-Po	Lithium-Polymer
MATLAB	Matrix Laboratory
MS	Millisecond
NI	National Instruments
NIOT	National Institute of Ocean Technology
NRL	Naval Research Lab
OCB	Oil Circuit Breaker
PC	Pressure Compensation
PTE	Pressure Tolerant Electronics
ROV	Remotely Operable Vehicle
RTD	Resistance Temperature Detector
SF6	Sulphur hexa-fluoride
SIO	Scripps Institute of Oceanography
SWE	South-West Electronic Energy
SERI	South-West Research Institute
US-NSDRC	United States Naval Ship Research & Development Centre
VRLA	Valve-Regulated Lead-Acid
W-h	Watt -hours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"You Get to Make Your Own Choices, but You Do Not Get to Choose Your Consequences"

"It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, ..."

Charles Dickens comes to our minds as we reflect upon the state of shipping today. Juxtaposed between Trade Wars, Galloping Technology, Regulatory Challenges and Climate Change issues, we could be looking like a deer caught in the headlights, unable to comprehend where our future lies.

The Lehman Brothers crisis of September 15, 2008, now close to 15 years ago; yet we have not been able to overcome its impact, just as we have never been able to avoid the odd bout of flu every winter, and of course the Covid-19. There has been a continuous stream of regulations, in the wake of galloping technology, escalating political gamesmanship across nations, safety management continuing to be an issue, and duty of care towards crew remains questionable.

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We would like stakeholders in the industry to come forward to make a case for Shipping, We invite you to Chennai and fearlessly present views to make the industry safe, environment friendly and investor supportive. In Chennai, one of India's largest cities and its cultural capital, you would find the rhythm and the beat to speak your mind, with an unwavering conviction and unfounded joy.

On behalf of the Organising Committee and The Institute of Marine Engineers (India), Chennai Branch, we extend a warm invitation to you and your organisation to actively participate and support the three day event, between December 4-6, 2024 in Chennai. We provide you in attachment, a copy of the canvas, and we hope to engage you in cool pre-winter periods in India.

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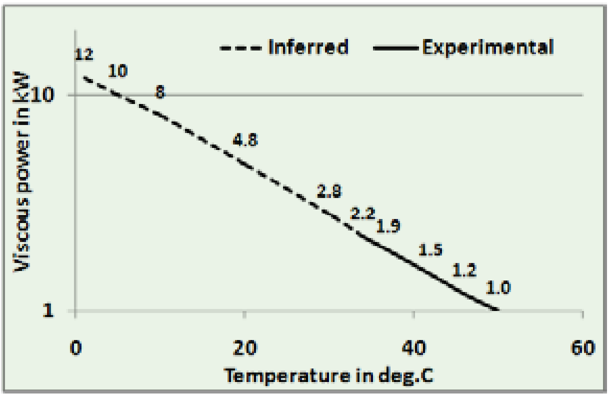

Figure. 20. Viscous power under 600 bar pressure and a range of temperature

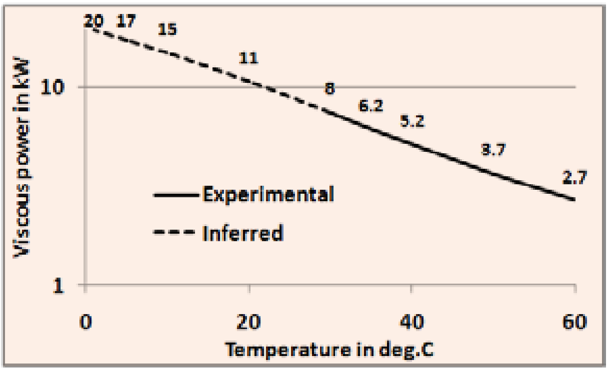

Figure. 21. Viscous power under 600 bar pressure and 2ºC

The viscous drag power observed for 60kW motor winding temperatures up to 50ºC is plotted in **Figure. 21.** The viscous drag power which was about 6 kW at 35ºC reduced to 2.7 kW at 60ºC. Based on experimental observations in the 35-60ºC temperature range, the viscous drag power inferred for lower temperatures are plotted in the same figure using dotted lines. It is inferred that, without any connected shaft load, an industry standard 60 kW PC deep sea motor could consume a power of about 17 kW at 600 bars during initial period after starting at 2ºC, compared to 2 kW at ambient conditions.

Thus, it is inferred that 30 kW and 60 kW subsea motors could consume a power of 33% and 28% respectively of their rated capacities when started at 600 bar pressure and 2ºC ambient temperature (the condition which prevails at 6000m water depths). The observations presented could be used for sizing of the subsea motor taking into consideration the increased starting power requirements due to viscous drag, design of suitable PC oil preheat systems for viscosity management and reducing the power requirements during motor starting conditions.

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Conclusion

With the increasing offshore activities, constant efforts are underway in various countries towards realising

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pressure tolerant electronics systems including discrete electronic components (resistors, capacitors, oscillators, isolators), electronic assemblies, integrated circuit chips, navigation sensors, optical devices, batteries (lead-acid, Li-Polymer), power capacitors, power semiconductors, fuses, circuit breakers, wet-mate connectors, electric motors and medium voltage variable frequency converters. Based on the experiences, it is clear that, though few components are designed or intended for operation in high ambient pressure environments, many are inherently pressure-tolerant, or can be made so through potting (reinforcing the structure to support internal void spaces) or porting (drilling to allow internal void spaces to fill with fluid).

When a PTE system is being considered, and no commercial-off-the-shelf (COTS) system is available, one of two approaches is possible. One approach is based on modification of an analogous 1-atm system for high-pressure operation and the alternate is the development of a PTE system from the basic electronic component level. The preferred approach depends on the cost and specialty of any analogous 1-atm systems, the likelihood of successful modification, the design elegance of the modification, the reliability requirement of the application, and economies of production. The observations and the inferences presented in this article helps to understand the design, construction, packaging and operational requirements for oil circuit breakers, lead-acid batteries and induction motors for ensuring reliable operation under hyperbaric conditions. The upcoming hyperbaric test chambers (including the 2.8m ID -900bar and 1.2m ID-1500 bar-2°C) in India's National Institute of Ocean Technology shall help in fostering research and development in pressure tolerant electronics.

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Coastal Communities: Sustainable Livelihood Opportunities

Kapildev Bahl

Abstract

Marine macroalgae, commonly known as seaweed, belonging to the Eukaryote domain and Protista kingdom in the classification table, are a range of multicellular plants that have no roots, stalks, leaves, flowers, fruits, or seeds. They grow by attaching themselves to rocky formations or other hard substrata beneath the water's surface or by drifting on the sea. These aquatic plants are an integral part of the ocean ecosystem. This paper highlights the sustainable livelihood opportunities for cultivating marine macroalgae and the socio-economic impacts it has on coastal communities.

I. INTRODUCTION

This paper highlights the sustainable livelihood opportunities that arise from cultivating marine macroalgae and the consequent positive socio-economic impact it has on coastal communities.

II. BACKGROUND

The study undertaken by the 'Indian Centre for Climate and Societal Impact Research' of the seaweed ecosystem [1] [2], commenced with the vegetative propagation of *Kappaphycus alverezii* seeds in a sterile, controlled-environment laboratory. When the seeds were satisfactorily hardened, the propagules were transferred to pilot scale land-based raceway tanks of 150,000-litre and 5000-litre capacity, in a semi-controlled environment. After ensuring robustness of the model, the process was validated with rigorous offshore field trials. Farming is traditionally carried out by coastal communities, using bamboo rafts. Therefore, various additional methods of cultivation were tried out with newer more versatile systems which enabled scaling up of operations, using more durable material. The farming technics were then eventually shared with the fishing and coastal rural communities, as part of skill development and capacity building programs for livelihood development and improvement. [3]

Another landmark initiative involved shore-tank based research on *Monostroma spp*. and *Glasilaria dura* seedling development, jointly with 'Central Salt and Marine Chemicals Research Institute' and 'Technology Information Forecasting and Assessment Council'

III. THE DILEMMA

The per capita income of several coastal communities is below the poverty line. Overfishing by large mechanized fleets, pollution from industrial plants and heavy infrastructure development along the coast have an adverse effect on marine life due to habitat destruction. This is impacting the livelihood of the dependent communities. India's economic growth and development demand a manifold increase in primary per-capita energy consumption. Fossil fuel utilisation is a major contributor to global warming, which has now become an existential threat to humanity. There is a global consensus for deep and immediate emission cuts of greenhouse gases, leading to net zero by 2050. Our inability to meet this dual challenge would mean either compromising on development or failing to realise the net-zero target timeframe or both. The 'Paris Pact for People and Planet' affirmed the goal that no country should have to choose between fighting for poverty reduction or fighting for the planet.

IV. THE SOCIO-ECONOMIC IMPACT OF SEAWEED CULTIVATION

a) Cultivation of seaweed delivers considerable social and economic benefits by generating additional employment and sustainable livelihood opportunities for the fishing and rural coastal communities, especially women. Seaweed farming augments and enhances existing incomes in the respective villages itself, without the need for migration from rural to urban areas.

Fossil fuel utilisation is a major contributor to global warming, which has now become an existential threat to humanity

b) The ideal strategy is to organize strategic partnerships with the underprivileged members of the vulnerable and marginalised communities to establish and build strong grassroots institutions, which are truly owned by the people. A formal model involves the establishment of local self-help groups (SHG) or building federations of SHGs which can be registered under the Society's Act as institutions for developing inclusive socio-economic growth strategies and providing sufficient capacity building. Associations normally consist of about 5 to 25 volunteers in a working group. One or two members of a family, typically below the poverty line, join the group. Office bearers of the association are chosen from within. Those above the poverty line are neither eligible for government subsidies nor for holding management positions. Guidelines for the formation of 'Fish Farmers Producer Organizations' have been promulgated by the government and disseminated by various bodies such as the National Bank for Agriculture and Rural Development.

c) One working model of engagement, which has been developed from experience, entails carrying out site selection and validation for suitability to cultivate seaweed, providing good quality seedlings, cultivation material and equipment, consumables and also training and skill development. Satellite imageries and geo-information system tools are increasingly used for data gathering and assessment. Site selection criteria comprise physical, chemical and biological parameters, such as sea-surface temperature, water salinity, pH, turbidity (NTU), phosphate (µg/l), nitrate (µg/l), nitrite (µg/l), depth of water at chart-datum, tidal range, tidal stream, significant wave height etc. It also includes studying the existing socio-economic conditions.

Case studies on ground have demonstrated the value of brochures and audio-visual documentaries which exhibit seaweed cultivation practices in the regional language. Records of the cultivation rope density, seeding rope density and line meter per unit of cultivation area, are meticulously maintained. Assistance is provided to the community in setting up innovative 'management information systems' including 'farm monitoring' techniques. These involve periodic visual and physical inspection of the bio-mass for signs of bleaching, infection, bacteria, fungus, barnacle, micro-bivalve or other algae, sand, mud, signs of grazing (fish, turtle, snail) or extraneous contaminants such as plastics. Farm management also includes monitoring and recording the colour, thallus diameter and evaluating the 'daily growth rate', by recording the weight of the bio-mass attached to the control cultivation-ropes; using the Hung et al. (2009) formula:

$$D.G.R. = [(F/I)^{(1/D)}-1]*100$$

Where

'F' is the present weight of biomass

'I' is the initial weight, and

'D' is the duration (interval) in number of days

Based on these calculations, the yield in kilogram per square meter of cultivation area is also periodically noted. Furthermore, atmospheric and meteorological conditions are monitored. The SHG mobilises the required number of personnel for deploying the cultivation material and equipment, seeding, farm management, harvesting, cleaning, weighing and packing. These operations are carried out under the supervision of marine biologists and cultivation managers. Wages are periodically settled on per person per day basis. The working contract is thus in the nature of material custody transfer and handling charges. [4] [5]

d) As and when the 'production groups' gain confidence, the community is encouraged to embark as an independent business entity. This model involves site selection and validation only. The SHG procures the seedlings, cultivation material and equipment as well as the consumables, initially by means of funding provided under schemes such as 'Pradhan Mantri Matsya Sampada Yojana' or government subsidies and eventually from their own resources. The SHG deploys personnel for fieldwork and ensures timely payments. The freshly harvested biomass can be sold by the SHG at the market rate per kilogram. Confidence and support may be provided by committing the purchase of freshly harvested seaweed bio-mass at a pre-determined rate, by means of a sale-purchase agreement.

e) These initiatives converge with prevalent developmental schemes of the government, whereby SHG can access revolving funds and capital expense subsidy for undertaking economic activities.

Case studies on ground have demonstrated the value of brochures and audio-visual documentaries which exhibit seaweed cultivation practices in the regional language

It empowers the community to access credit guarantee, financial institutional services and avail low-interest credit for viable income generation, including fast track approval and clearances, which are linked with bank micro finance.

f) These are sustainable models, with intrinsic advantages. It provides an opportunity to leverage SHG members' right to public assets including the access which the community enjoys to the waterfront and to harvest wild produce, not to mention the benefits of C.S.R. to commercial companies.

g) **The socio-economic impact of seaweed cultivation is distinctive because it provides livelihood opportunities not only to men but also to women, the latter being more suitable for activities involving attaching the propagule to artificial substrate and detaching the grown bio-mass ashore**. The men-folk are best suited for working off-shore. Although, women are thus engaged in larger numbers, experience has shown that indiscriminate female earnings may adversely affect the internal balance of the family support system and it is therefore important to strive for empowerment of rural women without destabilising the social fabric or causing disharmony in the family.

h) A third model of engagement with the communities, involve combinations of the above two, when for instance, the SHG is unable to mobilise sufficient funding to purchase the capital goods but has the necessary skills, experience and confidence to undertake the farming operations. Interest free loans may then be advanced to the SHG for purchasing the cultivation material and boats etc.

i) Except in very sheltered areas, fishing and seaweed cultivation activities cease during the monsoon season; the onset and withdrawal of which is itself undergoing erratic shifts. The communities traditionally tend to the repair and maintenance of their boats, gears and equipment or the management of their coastal agricultural or horticultural lands. However, asset-less and land-less families need to be supported with regular wages and an assured income throughout the year, even though the actual seaweed cultivation cycles are restricted to about eight months only. Therefore capacity building programs need to continue by initiating simple primary 'seaweed processing units' and / or seed bank operations, such that ample supply of potent and good quality propagule are made available to commence cultivation when the monsoon season abates.

V. PRODUCTS DERIVED FROM SEAWEEDS

Seaweed provides raw material and its cultivation leverages the market potential of processed value-added products to develop a sustainable circular ocean based blue economy.

Seaweeds are generally divided into the following three classifications.

VI. Rhodophyceae

A1. *Kappaphycus alvarezii* is a valuable source of K-Carrageenan that has various applications in the cosmetics, pharmaceutical and nutraceutical industry, as well as in the manufacture of bio-film packaging material, which are environment friendly in the true sense of the word, being both 'bio-derived' as also 'biodegradable' [9]

A2. *Gracilaria spp*. is a valuable source of Agar polysaccharide, which is used in the food and beverage industry

A3. K-sap, derived from *Kappaphycus alvarezii* is used as a formulation for agricultural inputs and bio-stimulants, which enhance plant resistance, immunity to disease and bacterial activity in the soil thus improving its quality, boosting crop yield and promoting plant growth [10] [11]

A4. The extract derived from *Asparagopsis taxiformis* when blended as a supplement to animal feed, increases nutrition and reduces enteric methane formation in ruminant livestock. [12]

VII. Phaeophyceae

Alginate, derived from various species such as *Sargassum spp*., *Turbinaria spp*. and *Cystoseira trinodis*, is used in the formulation of plant bio-stimulants and in the textile industry for fabric printing and dyeing [13] [14]

VIII. Chlorophyceae

Ulvan polysaccharide and Sulphated galactosan derived from *Ulva lactuca* and *Monostroma spp*. respectively, are used as food and food additives [15]

IX. ADDITIONAL BENEFITS

(a) Seaweeds photosynthesize in the presence of sunlight, absorb carbon dioxide from the atmosphere and release oxygen. [6] For example, twenty-six percent of the dry mass of *Kappaphycus alvarezii* consists of carbon [4]. Therefore precise quantification of carbon captured in the dry mass by means of laboratory analysis, provides an indication of the carbon credits above the baseline. Further research is needed to ascertain the additional carbon credits by 'Life Cycle Assessment' methodology and analysing the environmental impact of the substitute commercial product, principles and procedures for which are included in the 14000 series of environmental management standards in particular ISO 14040 and ISO 14044

(b) Seaweeds absorb excess pollutants and nutrients (originating from herbicide, fungicide and fertilizer run-off due to farming practices) from the seawater, thereby improving the quality of coastal seas. [7] [8]

(c) Seaweeds act as an important living resource and as habitat for various marine species, restoring marine biodiversity and stabilising coastal ecosystems.

(d) Seaweeds do not require arable land or freshwater, and grow without the need for introducing external fertilizers

(e) Seaweeds contribute to the blue economy and advance some of the Sustainable Development Goals of the UN

1 (poverty),

2 (malnutrition),

8 (decent work),

11 (sustainable communities),

13 (climate action),

14 (marine biodiversity).

X. POLICY FRAMEWORK INTERVENTIONS

(a) It is difficult to enumerate a uniform policy framework, without contextualising the nuances of each issue. But the following broad areas require intervention to address the complexities and potential regulatory roadblocks which are impediments to the growth of the seaweed industry [16]

(b) The Ministry of Earth Sciences is responsible for the conservation and sustainable use of oceans and marine resources. The Economic Advisory Council to the Prime Minister of India has evolved a policy approach to drive the blue economy and ocean-based economic development. The Coastal Aquaculture Authority Act, 2005 has been recently amended to include the term 'any other aquatic life' under the definition of coastal aquaculture. Coastal aquaculture and activities connected therewith are now permitted within the CRZ. The amendment replaces punishment with suitable civil instruments such as penalty, in line with the principle of decriminalising civil transgressions. Rules under this act, specific to seaweed cultivation, need to be framed in a user friendly manner, so that India becomes self-reliant in the value added products which are presently imported

The government's existing policy is to encourage the cultivation of seaweed as a socio-economic and environmental initiative

(c) Good quality seedlings is the key to farm sustenance. Harvesting the entire crop and re-seeding with healthy propagule, enhances the quality and productivity of the seaweed crop. Rhodophyceae are being cultivated widely in India, of which *Kappaphycus alvarezii* is the most significant commercially viable species which can anchor the livelihood of farmers. Years of extensive vegetative propagation and reuse of the same seed material has adversely affected the vigour and quality of the propagule, leading to reduced productivity and making it prone to bacterial and fungal infection. There is a need to import good quality seeds of several commercially important species for the purpose of strain improvement and research. A liberal import policy of special seaweed species, quarantine and acclimatisation protocol is needed. [17]

(d) The legal framework governing 'reserved' and 'protected' areas, is well established. Law mandates the following categories.

Reserved Forest Areas, which are notified under Indian Forest Act, 1927.

Protected Areas, consisting of National Parks (core), Wildlife Sanctuaries etc., which are notified under Wildlife Protection Act, 1972, Biodiversity Sites notified under the Biological Diversity Act, 2002 and Wetlands, which are notified under Wetland (Conservation and Management) Rules, 2017 Furthermore Marine National Parks, Marine Sanctuaries and Ports Limits etc. have also been identified. Taking into consideration the environment, governance and social aspects; there is a need to delineate and allocate specific areas for seaweed cultivation. Demarcation of farm anchoring zones away from fishing and other areas, may also be considered to avoid mooring systems having to be dismantled frequently.

(e) The government's existing policy is to encourage the cultivation of seaweed as a socio-economic and environmental initiative. However, to achieve the stated production target of about 12 million tons per annum, there is a need for parallel, commercially viable, large-scale models of offshore cultivation. This requires a legal and policy framework and regulatory mechanism in order to encourage commercialisation of seaweed cultivation. Given that the ownership and management of the coastal seas, vests with the State (thus being beyond the purview of private ownership) and considering that this public asset is commonly used by multi-stakeholder interests, it may best be governed by means of a sea-area leasing policy framework. The framework should specifically grant priority to the relevant coastal communities, with a provision facilitating the sub-lease for commercial scale farming. There should be adequate involvement of the community ensuring in-built rights so as to have a say in the harvested material therefrom.

(f) In the same manner, ownership of coastal lands vest with the state. Seaweed cultivation needs un-interrupted waterfront access. A policy for allocation or leasing of coastal land to the local communities, for the purpose of boat landing jetty and establishing seaweed hubs, needs to be considered. A single nodal agency for granting permits and monitoring oversight may be considered. [18]

(g) Existing fishing boats, duly registered under the 'Merchant Shipping Act' double-up as seaweed farming boats. The operation of such boats are regulated by the Fisheries Department, based on the necessity to control fishing activities and for safety of life and property during the monsoon season. There is a need to provide for ownership and separate registration of seaweed cultivation boats, operations of which are required throughout the year. Sea-going personnel engaged in offshore seaweed cultivation need to be issued identity cards

(h) There is a need to evolve a mechanism to equip the farmers to accumulate carbon credits and also to provide access to carbon markets by monitoring and reporting cultivated quantity.

(i) A suitable mechanism to recognise seaweed's potential to remove excess nutrients (such as nitrogen and phosphorous) from the sea and reduce acidification, needs to be implemented

(j) Supporting the development of ancillary industries that utilise the seaweed produced, would greatly encourage and accelerate cultivation

(k) Organising a structured seaweed crop insurance facility, is essential for the growth of the industry

(l) There is a need to establish at least one seaweed hub based on the concept of a fully integrated agro-industrial park consisting of:-

(i) Laboratory with provision for a semi-controlled and semi-sterilised environment for vegetative propagation, micro-propagation and seed hardening

(ii) QA/QC Laboratory with facilities for analysis of propagules, grown bio-mass, value-added processed products, formulations and innovative / novel products

Except in a few sheltered areas, the vast coastline is exposed to strong winds, rough seas and moderate swell

(iii) Seed bank to ensure that good quality seeds are readily available throughout the year. Although India is blessed with a huge coastline and a vast Exclusive Economic Zone, the west and east coasts experience monsoon seasons, during the months of July to September and/or November to January. Except in a few sheltered areas, the vast coastline is exposed to strong winds, rough seas and moderate swell. There is thus invariably a shortage of good quality acclimatised seed material, when the cultivation season resumes after the monsoon season. Transporting mature thalli results in huge mortality rates and consequent handling losses. The farmer is thus compelled to commence operations on a small scale and spend the initial couple of cultivation cycles without any sales from harvest, because the produce is required for growing seeds. This constraint therefore reduces the number harvestable cycles and consequently the per annum yield of the sea area. Seed banks need to be established in every coastal state. However, land-based shore-tank nurseries are not only capital intensive, but also operationally expensive. The seed bank should therefore consist of a combination of land-based and sheltered off-shore areas

(iv) Boat landing facility such as a jetty, wharf or pier, to ensure that freshly harvested bio-mass can be landed ashore at all stages of the tide. In the absence of such facilities, farmers have to haul their boats on the beach. Dragging the produce, results in the material getting contaminated with sand, mud and extraneous material. A suitable landing site also increases the turn-around time of the boat and increases the efficiency of the operation.

(v) Paved platforms (for solar-drying the harvested material), warehousing, logistics & transportation facilities

XII ACKNOWLEDGMENT

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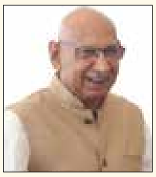

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Troubleshooting of Alternators Part 3A

Elstan A. Fernandez

Introduction

Troubleshooting of Alternators is published in three parts. Part 3 (in 3 parts), presented in this article has tabulated information to help an engineer to quickly scan through and address related issues (that are mentioned in this article.

1 Troubleshooting and Restoring PMGs and Contaminated Brushless Alternators

1.13 Separately Excited Control System with Permanent Magnet Generator (PMG)

1.13.1 The Permanent Magnet Generator (PMG)

The PMG rotor shaft is located onto the non-driven end of the generator shaft. A spigot fits over the shaft end, and the whole assembly is secured by a single bolt through the PMG rotor, into a threaded hole in the shaft. The PMG stator is fitted to the non-drive end bracket of the generator, either directly into a spigot on the non-drive end bracket, or bearing cap, or into a housing as shown in Figure 10.

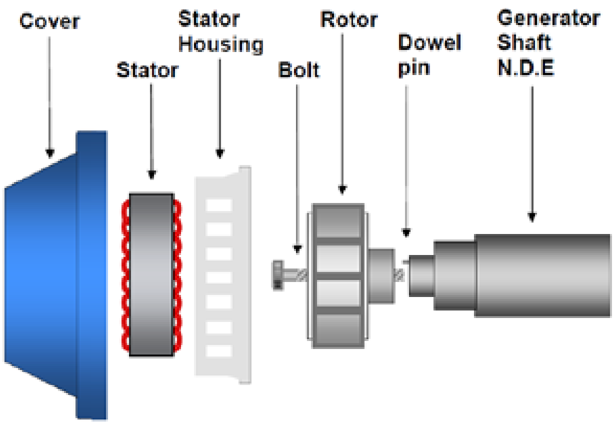

Figure 10(a). A PMG Mounted on an Alternator
Image Courtesy: Stamford Alternator Manual

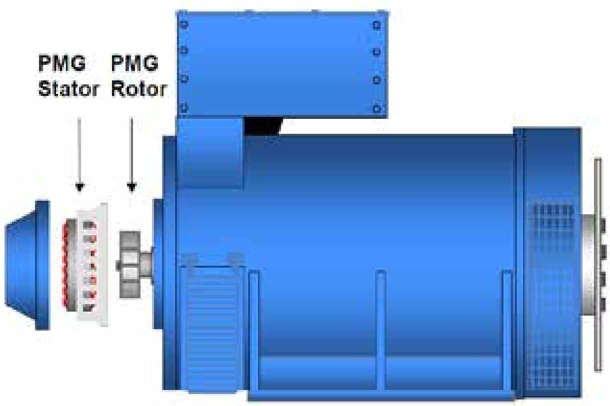

Figure 10(b). A PMG Mounted on an Alternator
Image Courtesy: Stamford Alternator Manual

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1.13.2 PMG's Manufactured Before 1983

The PMG stator has a lead marked P1, which is the neutral connection. The voltage from P1, (Neutral), to P2, P3, and P4 should be /1.732 of the phase-to-phase voltage.

***Note:** This lead is not required for later AVR types, and can be removed if the original AVR is replaced.*

1.13.3 PMG Powered AVR's

The PMG provides an independent power supply for the Automatic Voltage Regulator (AVR).

1.13.4 Testing the Permanent Magnet Generator

The PMG can be tested as an independent generator. Disconnect the AVR power supply leads marked P2, P3, P4, from the AVR terminals. Run the generator at nominal speed (the speed must be correct for accuracy of results).

Check the PMG output Voltage across leads P2, P3, and P4 with a multimeter, set to AC volts.

For 50 Hz generators, the voltage across P2, P3 and P4 should be approximately 170 V AC.

For 60 Hz generators, the voltage should be approximately 200 V AC.

1.14 Separately Excited Control System with PMG Test Method B

1.14.1 Fault Symptoms and Remedies at No Load

Symptoms	Probable Causes	Remedy
No Voltage (No Load)	Faulty permanent magnet generator (PMG), stator or rotor.	Disconnect the PMG leads from AVR terminals P2, P3, P4. Check voltage across leads with a Multimeter, with the set running at correct speed. For 50Hz, the voltage across P2, P3 and P4 should be approx. 170 V AC. For 60Hz, the voltage is approx. 200 V AC. Pre 1983 machines. Lead P1 from the PMG is the Neutral. Voltage should be P1 to P2, P3, and P4 ÷ 1.732 of the phase-to-phase voltage.
	Insulation failure to earth, (ground), on permanent magnet stator.	Disconnect leads P2, P3, P4 and, 'Megger' test to earth
	Voltmeter faulty.	Check and verify voltage at Generator output terminals with a Multimeter.
	Loose, broken or corroded connections.	Check connections, repair and replace where necessary.
	AVR high excitation protection circuit activated, collapsing output voltage. (AVR protection circuit is factory set to trip at 70 V DC across AVR output)	Check if AVR LED is LIT, indicating protection circuit activated. Shut down the engine, and run up again. If the voltage builds up normally but collapses again, the protection circuit has operated, and AVR LED will be lit. Run again and check the excitation voltage across A.V.R X+ (F1) and XX- (F2). If greater than 70 VDC, the protection circuit is operating correctly. Refer 1.10 also
	Main Rectifier diodes short circuit.	Check diodes.
	There is an open circuit fault in the exciter's stator windings.	Remove the external leads from the generator, and carry out all tests as per article 1.10
	Faulty AVR	Replace the AVR and re-test it.
	There is a winding fault, open circuit or short circuit.	Remove the external leads from the generator, and carry out all tests

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Symptoms	Probable Causes	Remedy
Low Voltage (No Load)	The engine speed is low	Check the LED on the AVR. If it is lit, the UFRO protection has activated, indicating low engine speed. Adjust the engine's speed to the correct nominal.
	Under frequency protection (UFRO) circuit operated.	Check if the LED on the AVR is lit, indicating low engine speed. Adjust the engine speed to within –1% to +4% of the nominal.
	The voltmeter is faulty or 'sticking'.	Verify the voltage across the Generator's output terminals with a multimeter
	The AVR 'VOLTS' adjuster is incorrectly set	Adjust the control knob CLOCKWISE to increase the voltage. If the remote hand trimmer is fitted, adjust it in conjunction with the trimmer.
	Faulty AVR	Replace the AVR and re-test it.
High Voltage (No Load)	The AVR 'VOLTS' adjuster or the remote trimmer is incorrectly set.	Check and adjust it as necessary.
	Low sensing supply from the main stator.	Check the sensing supply as per article 1.11
	Sensing supply is open circuited	Open circuit or low sensing signal will cause the AVR to produce high excitation, which will produce a high output Voltage. Check the sensing supply as per article 1.11
	The burden resistor is open circuited. (Pre 1989 machines only).	Disconnect the burden resistor, (fitted in the terminal box), and check the resistance (215 ohms). Also check the tapping bands and connections for corrosion and tightness.
	Faulty AVR.	Replace the AVR and retest the machine
Unstable Voltage (No Load)	Engine speed 'hunting' (unstable).	Check with a frequency meter or tachometer for speed variations due to governor 'hunting', or cyclic irregularities in the engine. This may improve as load is applied.
	Permanent magnet stator incorrectly positioned. (Pre 1989 AVR only).	The radial position of the stator housing is important for the stability and response of the AVR. (Refer 1.5.5 - Excitation Voltage at No Load). Later AVR models do not require this adjustment.
	AVR stability control incorrectly adjusted.	Adjust stability clockwise until voltage stabilises. Check again on load.
	Loose or corroded connections.	Check the auxiliary terminals for loose connections. Repair or replace as necessary

Symptoms	Probable Causes	Remedy
Unstable Voltage (No Load)	Intermittent earth on machine.	Megger all windings, (see 1.2), including Exciter Stator, low insulation resistance can affect the AVR.

Symptoms	Probable Causes	Remedy
Unbalanced Voltage (No Load)	Fault in the main stator winding.	Disconnect all external leads to the generator and re-test. Separately excite the generator. A shorted winding will get hot, and the engine will sound slightly loaded. Shut down the set and check it for hot spots.

About the author

Elstan Fernandez has an experience of 44 years in the Maritime and Energy Industries. He has been an Author / Co-author of 80 Books. He holds the statuses of Chartered Engr, FIE, MIET (UK), MLE℠ Harvard Square (USA). He is the Joint Inventor with a Patent for Supervised BNWAS and won the Promising Indian of the Year in 2017

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WHAT'S IN A NAME?

Figure 1. INS Imphal Source: Wikimedia Commons
https://en.wikipedia.org/wiki/INS_Imphal_(D68)#/media/File:INS_Imphal.jpg

Janhavi Lokegaonkar

The naming of naval assets is a time-honoured tradition that carries historical significance, instilling a sense of pride and continuity within a naval force. The early nomenclature of the naval vessels often drew inspiration from British naval traditions. Before gaining independence in 1947, the Royal Indian Navy, as it was known then, largely followed the naming conventions of the Royal Navy. Ships were often named after geographical locations, historical events, or eminent personalities associated with the British Empire. This practice underscored the colonial nature of the naval force and its allegiance to the British Crown. Despite the influence of these colonial conventions, the ships commissioned in the Royal Indian Navy had a distinct Indian orientation to them. For instance, *HMIS Madras, HMIS Jumna, HMIS Bombay, HMIS Kistna* etc. The names were drawn from the undivided Indian milieu which were of paramount importance to the British. However, as India became a Republic in 1950, a shift towards indigenous nomenclature became evident.

> *Despite the influence of these colonial conventions, the ships commissioned in the Royal Indian Navy had a distinct Indian orientation to them*

The transition from colonial rule to an independent nation marked a significant shift in the naming conventions of the Indian Navy. The newly formed naval force sought to establish its distinct identity by adopting names that resonated with India's cultural and historical roots. It was a conscious effort to imbibe nationalistic fervour and cultural pride in the names of naval assets. Ships and submarines began to be christened after rivers (*INS Ganga, INS Godavari, INS Beas, INS Sutlej*), mountain ranges (*INS Shivalik, INS Satpura, INS Sahyadri*), and mythological characters (*INS Savitri, INS Krishna, INS Subhadra*), reflecting a desire to project India's rich cultural diversity and historical heritage. This shift aimed to establish a unique Indian naval identity distinct from its colonial past.

As India's geopolitical standing evolved, so did the considerations in naming naval assets. In certain periods, ships were named to assert strategic interests or commemorate significant strategic events. For instance, names reflecting strength, resilience, and national unity gained prevalence, reinforcing the symbolic importance of naval nomenclature (*INS Talwar, INS Kirpan, INS Veer, INS Nashak*). Ships and submarines are often named to evoke a sense of strength, resilience, and power (*INS Vikrant, INS Sindhughosh, INS Vikramaditya*). The Indian Navy also had the vision and made a strategic move to clear the ownership of the island groups, especially in Andaman, Nicobar and Lakshadweep. Ships like *INS Androth, INS Kadmatt, INS Kabra, INS Batti Malv,* etc are named after these islands which asserts their place of importance in India. This step towards inclusiveness with the choice of names is all the more important which reflects India's diplomatic and geopolitical considerations, projecting her naval capabilities and aspirations on the global stage.

> *The auxiliary vessels like the tug boats which are used by the Navy for instance are named after contemporary Indian personalities like BC Dutt, Madan Singh who played a major role in the Royal Indian Navy Uprising in 1946*

The naming process in the Indian Navy is deeply intertwined with cultural symbolism. **Many naval shore establishments like *INS Angre, INS Shivaji, INS Kunjali, INS Zamorin,* etc. are named after eminent personalities, leaders, or historical figures who have made notable contributions to the Indian maritime heritage**. The auxiliary vessels like the tug boats which are used by the Navy for instance are named after contemporary Indian personalities like BC Dutt, Madan Singh who played a major role in the Royal Indian Navy Uprising in 1946. This not only pays homage to the legacy of these individuals but also instils a sense of pride and inspiration among the Indian naval personnel. The first Indian warships, such as *INS Delhi* and *INS Mysore*, reflected this transition, paying homage to cities and regions with historical significance. Additionally, the use of symbols, mythological references, and Sanskrit names adds a unique flavour to the nomenclature, encapsulating the essence of Indian identity. In contemporary times, the Indian Navy has continued to evolve its naming conventions in response to changing international dynamics and technological advancements. The adoption of indigenous shipbuilding programs, such as Project 15 (*INS Kolkata, INS Visakhapatnam, INS Mormugao*) has led to the introduction of new classes of ships with names that reflect a modern and forward-looking approach.

In recent years, there has been a discernible trend towards modernization and global integration in the nomenclature of Indian Navy assets. The naming of Indian Navy ships continues to evolve, mirroring the nation's aspirations and global responsibilities. The Internal Nomenclature Committee at the Indian Naval Headquarters, New Delhi is responsible for proposing the names for the ships, submarines and other establishments which become an integral part of the Indian Navy. The proposed names then go through further bureaucratic procedures with a thorough assessment of the importance and significance of the proposed names after which the name is finally approved by the President of India in their capacity as the Supreme Commander of the Indian Armed Forces. The process is meticulous, involving consultations with naval historians, cultural experts, and relevant authorities. The names are chosen to instil pride, evoke a sense of history, and project a strong national image.

The Indian Navy welcomed a new addition to its formidable fleet - the INS Imphal, a warship that holds a special connection with the North-eastern region of India. INS Imphal was commissioned in the presence of

Figure 2 Crest of INS Imphal Source: Wikimedia Commons
https://en.wikipedia.org/wiki/INS_Imphal_(D68)#/media/File:INS_Imphal_(D68)_crest.jpg

Hon'ble Raksha Mantri Shri Rajnath Singh at an impressive ceremony held at the Naval Dockyard, Mumbai on 26 December 2023.[1] The ship is indigenously designed by the Warship Design Bureau of the Indian Navy and constructed by Mazagon Dock Limited and was delivered to the Indian Navy more than four months ahead of the contractual time.[2] It is built using 'Indigenous Steel DMR 249A and is amongst the largest Destroyers constructed in India, with an overall length of 164 meters and a displacement of over 7500 Tons.'[3]

The naming of the warship 'INS *Imphal*' pays homage to the resilience and bravery of the people of Manipur and the unbreakable spirit of the North-eastern region. This North-eastern connect is also a reminder of the exploits of heroes like Lachit Borphukan at the 'Battle of Saraighat (1671)'[4]. The victory of the Ahoms against the Mughals was rendered possible due to the tactics employed by Borphukan and his troops as they decided to fight the battle on the mighty Brahmaputra river which was a direct attack on the weak spot of the Mughals - its Navy. Their victory is a lesson that underscores the strategic importance of the riverine topography and familiarisation of coastal geography when comes to safeguarding and policy planning of the Indian maritime frontiers. The ship's crest design depicts the 'Kangla Palace on the left and 'Kangla-Sa' on the right. The Kangla Palace is an important historical and archaeological site of Manipur, and was the traditional seat of the past kingdom. With a dragon's head and lion's body, the 'Kangla-Sa' is a mythical being from Manipur history, and is symbolic as the guardian of its people. 'Kangla-Sa' is also the state emblem of Manipur.'[5]

INS *Imphal* also serves as a powerful symbol of India's commitment to the development and security of the North-eastern region. It accentuates the strategic importance of the region, which shares borders with several neighbouring countries, including Myanmar, China, and Bangladesh. The presence of a warship named after a North-eastern city on the international maritime stage highlights the region's role in India's strategic and diplomatic efforts. It promotes a sense of pride and belonging among the people of Manipur and the entire Northeast.

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INS *Imphal* is a Kolkata-class stealth guided-missile destroyer, a highly versatile and modern vessel that boasts advanced weaponry and state-of-the-art technology. As one of the most potent warships in the Indian Navy, it is well-equipped to meet the challenges of modern warfare and maritime security. As it has commissioned into the Indian Navy, INS *Imphal* will continue to strengthen India's naval capabilities and play a crucial role in safeguarding the nation's interests in the maritime domain.

The nomenclature of Indian Navy ships, submarines, and establishments is a dynamic and multifaceted process, shaped by historical, cultural, strategic and diplomatic considerations. From the early post-independence period to the present day, the trajectory of naming trends reflects the evolving identity and aspirations of the Indian Navy. For the Indian Navy, the practice of assigning names to vessels goes beyond mere identification, encapsulating a blend of cultural, historical, and strategic considerations and naval ethos. The practice is steeped in history, culture, and strategic foresight, serving as a powerful symbol of India's maritime strength and global responsibilities, and continues to be a nuanced and thoughtful process, reflecting India's rich heritage and contemporary geopolitical imperatives.

For the Indian Navy, the practice of assigning names to vessels goes beyond mere identification, encapsulating a blend of cultural, historical, and strategic considerations and naval ethos

As the Indian Navy sails into the future, the tradition of ship naming will undoubtedly play a crucial role in shaping its identity and legacy. So, when they ask '*What's in a name*?' – It is a legacy.

References

1 Raksha Mantri commissions stealth guided missile destroyer INS Imphal in Mumbai. Press Information Bureau dated 26 Dec 23. Accessed and retrieved through https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1990408#:~:text=INS%20Imphal%2C%20a%20Project%2015B,Mumbai%20on%20December%2026%2C%202023.

2 Ibid.

3 *'IMPHAL' - Third Stealth Destroyer of Project 15B delivered to the Indian Navy*, Press Information Bureau dated 20 Oct 23. Accessed and retrieved through https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1969358

4 Battle of Saraighat. Accessed and retrieved through https://indianculture.gov.in/stories/battle-saraighat

5 *Raksha Mantri Shri Rajnath Singh unveils crest of Project 15B stealth guided missile destroyer Yard 12706 (Imphal),* Press Information Bureau dated 28 Nov 23. Accessed and retrieved through https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1980365

About the author

Ms Janhavi Lokegaonkar is a PhD student at the Department of History, University of Mumbai. She currently works as a Senior Research Associate at the Maritime History Society (MHS), Mumbai – an academic initiative of the Western Naval Command, Indian Navy. Ms Janhavi has been actively presenting papers at various national and international conferences and has credible publications in the maritime domain.

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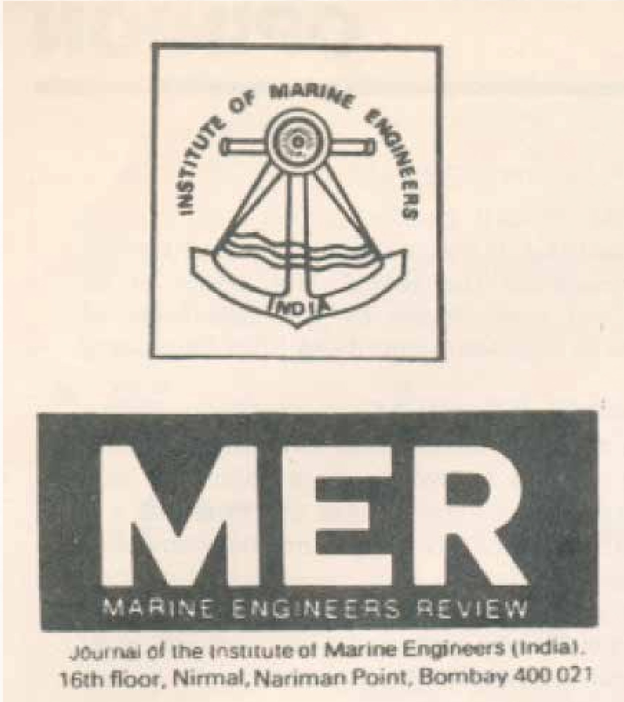
Going Astern into MER Archives…



The April 1984 issue has a brief editorial upfront highlighting the need to look at MET in India. It calls for a meeting of all stakeholders including the Maritime Union, Ship Repairers etc. It proposes that IMEI may cull the relevant points and elevate them to the GoI. The clarion call is apparently inspired from a recently (then) held Conference on MET.

The OPINION has a lament on the British decision not to extend the first year investment allowance for newbuildings. The industry's hope was that the incentive would have been extended to second hand tonnage purchases.

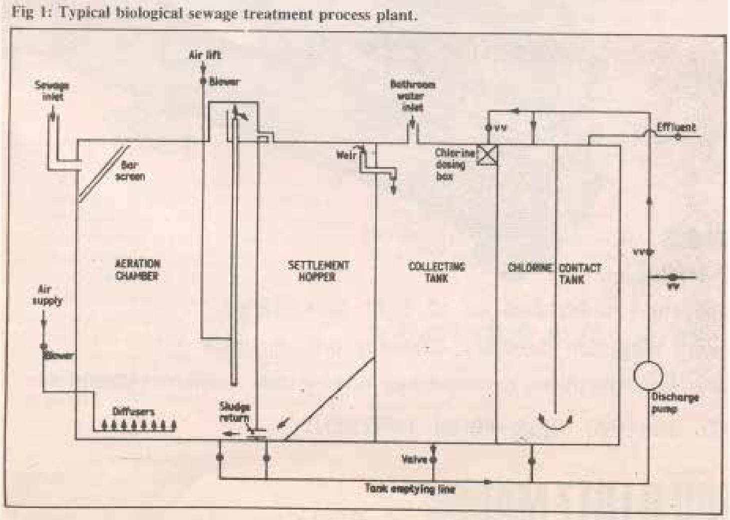
If one may recall, those were times when tonnage crunch had spread all over.

The second opinion is an interesting one. It talks of a coming together of LR, BV and Council of ICE makers for establishing crankshaft stressing method, which could be acceptable to CS and OEMs. It talks about varying standards amongst CSs and also comments on the proliferation of (Classification) 'Societies of Convenience', which had increased the competition.

The main section starts with an informative article on sewage systems. Action by IMO and few individual national initiatives, STP was becoming a regular feature. The article analyses how the treatment systems function and few analyses of samples from various vessels.

This is followed by an article on Chemical Treatment of water systems on board. The systems include boilers, DE systems, FWG etc. This will be familiar territory for all practicing marine engineers. Some pictures extracted to evince interest.

Fig 1: Typical biological sewage treatment process plant.



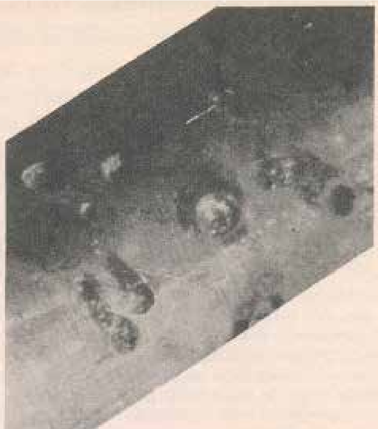


Fig 4: Oxygen pitting corrosion on boiler tube. The gas is dissolved in the feedwater unless this is suitably treated.

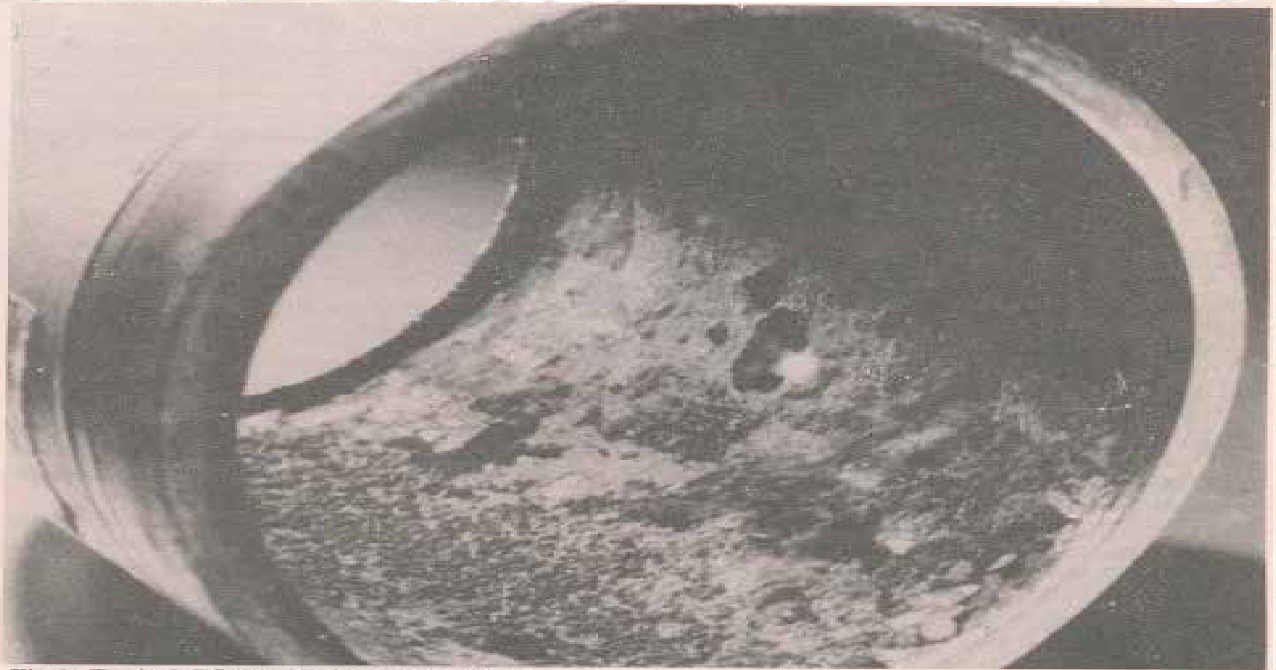


Fig 1: Typical CO_2 attack inside pipework.

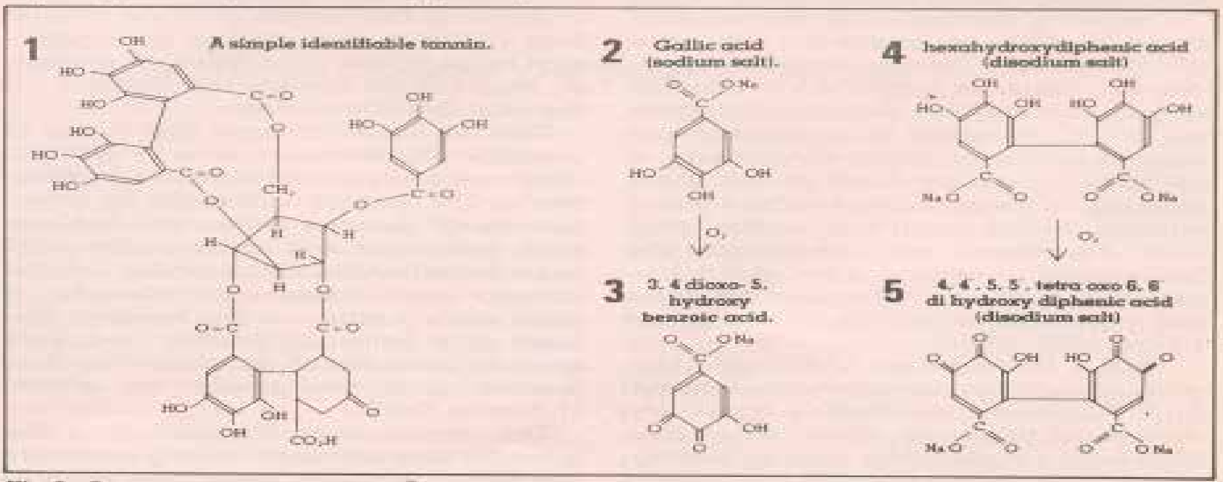
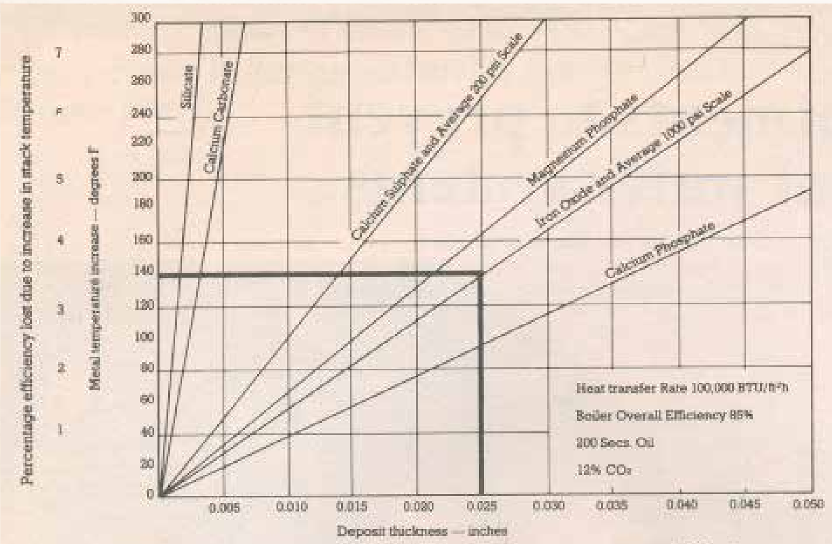


Fig 2: Oxygen scavenging by tannins: 3 and 5 are unstable intermediates.



Example — what is the effect of 0.025" of iron oxide or average high pressure scale? Metal temp. increase 138°F loss of efficiency 3½%

Fig 3: Effects of varying thicknesses of different deposits.

Then there is more on the sewage... explaining functioning of vacuum toilets. The vacuum system works towards efficiency and reduces water consumption (about one tenths of a conventional system).

The system evacuates the soil as the created vacuum in piping (on pressing the flush button) opens the water inlet and toilet discharged for a limited short period of time (2 seconds). This creates a suction effect and the high velocity evacuation and with only little water which helps with the flushing. Aircrafts have been using these and so have many cruise ships.

Engineers who would have worked on these will have horror stories to narrate, mainly due to users' lack of knowledge and application.

Fig 1: System typical for large passenger ships. The vacuum pumps draw from the vacuum tanks.

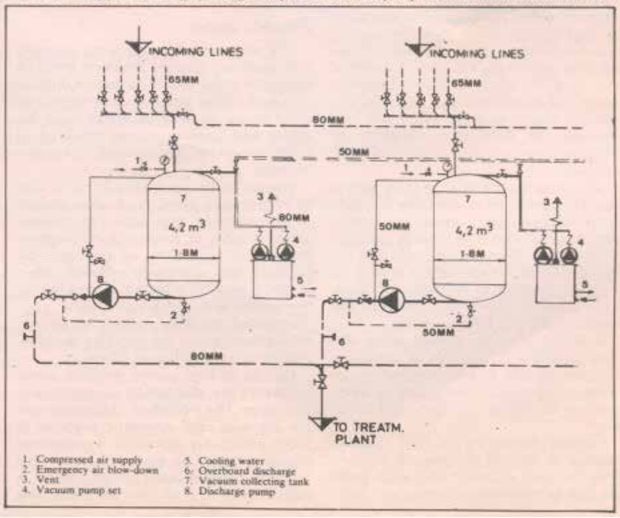
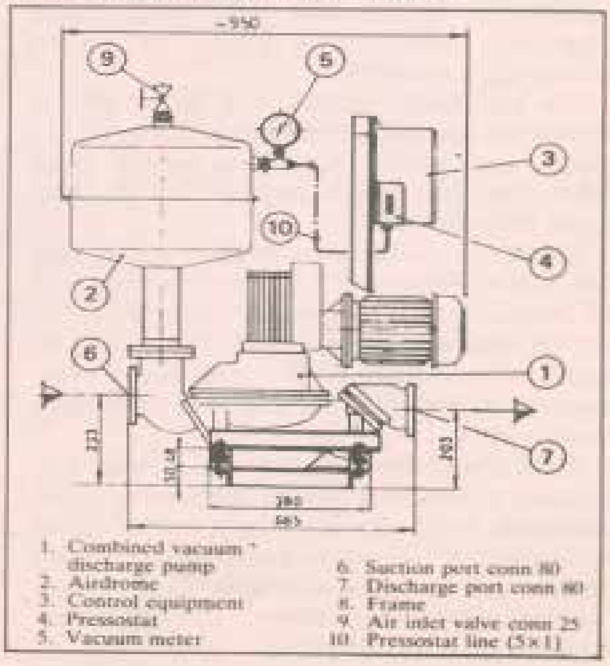


Fig 3: The Minivac for 30 flushes/h.



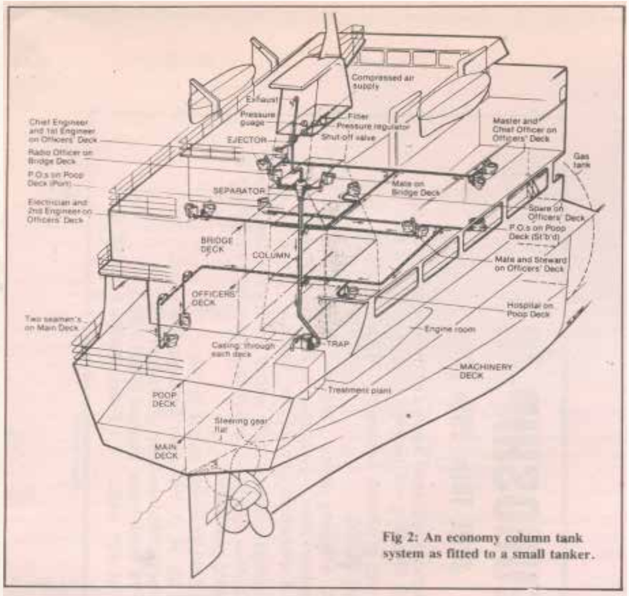


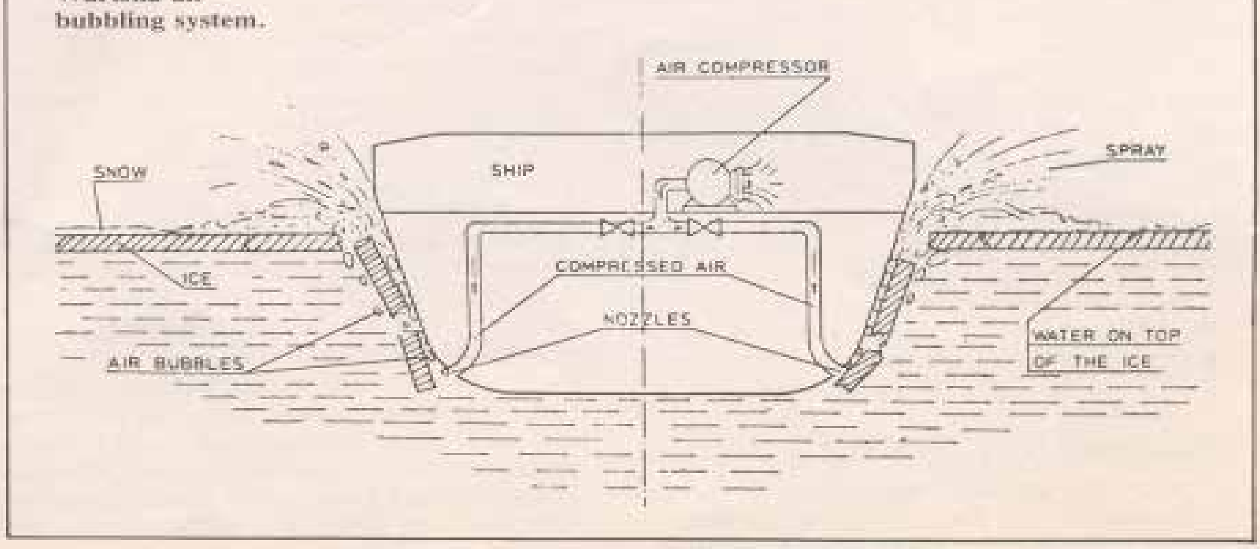
Fig 2: An economy column tank system as fitted to a small tanker.

Then there is a comparative discussion on RO and evaporators. This is an interesting read.

This is followed by a historical write-up on Chatham Royal Dockyard which was being closed after 437 years (established by Henry VIII). Then a Conference paper on designing electrical systems for warships is featured. This is an easily understandable read and quite absorbing also as many of the electrical system features typically apply to many merchant vessels. The discussions which follow the paper and the Author's responses are great takeaways.

There is a write-up on how to break through the Arctic ice. This could be of topical interest.

Wärtsilä air-bubbling system.

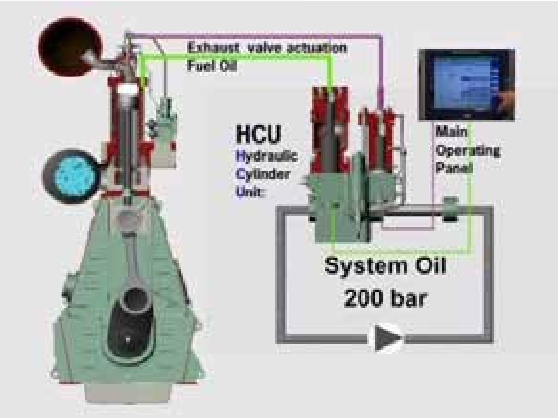


We invite observations, discussion threads from readers, taking cues from these sepia-soaked MER pages. – Hon.Ed.

MASSA Maritime Academy, Chennai

The Institute of Marine Engineers (India)

Electronic Engine Familiarisation Course (ME-Type Engine)
Delivered online with Cloud access to ME Engine Simulator



This 3 days course is designed for all Ship's Engineer Officers and Electro Technical Officers responsible for the operation of ME Engine. This course consists of technical lessons and practical instructions on the design, principles, operating procedures and maintenance activities for the safe, efficient and optimal performance of the engine system.

Course Aims and Objectives:

The course aims to provide practical understanding of the principles, design, operation and maintenance of the ME Engine System, enabling participants to safely and efficiently operate the engine and perform fault-finding in the control system.

Coverage / Program Focus:

This course deals with the following training areas:

- **Introduction to ME Engine**
- **Hydraulic Power Supply (HPS)**
- **Hydraulic Cylinder Unit (HCU)**
- **Engine Control System (ECS)**
- **Main Operating Panel (MOP)**
- **Standard Operation**

Entry Requirement / Target Group:

Entry is open to all Ship's Engineers and Electro Technical Officers with basic knowledge of diesel engines.

DATE & TIMING : **23rd – 25th Apr 2024/ 28th – 30th May 2024/ 25th – 27th June 2024/ 29th – 31st July 2024/ 27th – 29th Aug 2024/ 24th – 26th Sep 2024/ 28th – 30th Oct 2024/ 26th – 28th Nov 2024/ 17th – 19th Dec 2024**
8:00 am - 4:00 pm IST

VENUE : Web Platform / Zoom. **APPLICATION LINK:** https://imeimum.marineims.com/course/register

REGISTRATION & PAYMENT : Rs. 15,000/- /- per participant – inclusive of taxes.
For IME(I) Members 13,500/- per participant - inclusive of taxes.
Payment to be made to: https://imeimum.marineims.com/course/registe
(Under Category - Value added Courses) *10% discount available for IME(I) members*

FOR MORE INFORMATION : **@IME(I) - email:** training@imare.in, Ms. Anukampa
(M). 9819325273, **(T)** 022 27701664 / 27711663 / 2771 1664.
@ MASSA Maritime Academy Chennai - email: mmachennai@massa.in.net
Ms. Saraswathi, **(T)** 8807025336 / 7200055336 .

After registration and payment, please email the details of the receipt to: ***training@imare.in***

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