Marine Engineering and LNG Fundamentals

Principles of Marine Engineering - Components, Maintenance Prevention and Diagnosis for Non-Marine Engineers.

About the Course.

This course is designed to introduce and enhance the knowledge and concepts of marine engineering for those in non-technical professional roles that are involved in vessel and operations, offshore, subsea and the shipping industry. Designed for non-technical professional personnel; or those requiring a more advanced level of understanding in marine engineering. This course will benefit those who require greater understanding of marine engineering principles.

The course provides instructions regarding marine engineering and mechanical components, diesel, LNG and petrol engines, mechanical wear down, piston and bearing failures, exhaust and valves, engine checklists, engine vulnerabilities and the internal mechanics of combustion engines and its components in a marine environment.

The course is designed for participants with a limited level of knowledge of marine engine design and operation including; back-office personnel, marine asset supervisors, part procurement managers, Planned System Maintenance and Operational managers, underwriters and insurers entering the maritime industry, and Deck Officers.

In addition, learn new technological marine engineering concepts, vessel procurement efficiencies, LNG and clean fuel technology, maintenance and reliability techniques of new and improved marine engineering assets. It will provide you with techniques, procedures and resources to manage and understand the technical aspects of marine engineering, mechanics and propulsion in a maritime and offshore environment.

Key Topics Covered

MASTER the necessary knowledge and complexities of;

1. Marine 4 and 2 stroke marine engines and components
2. How to determine failures and diagnose faults
3. Successfully understand, operate and manage engines in a marine environment
4. Internal Marine Engine Components and systems
5. Pumps, failures and maintenance best practices
6. The fundamentals of LNG and clean fuel technologies
7. Mechanical service life limitations and life cycles
8. LNG, Hydrogen Fuel, Diesel and Petrol driven mechanical operations and mechanics
9. The correct use of Lubrication, Oils and purification methods
10. Cooling systems and marine engine overheat
11. Engine room components, systems and layouts
12. Trouble shooting for Superintendents, Marine managers, Offshore Project managers
13. Auxiliary Generators [Genset] – components and operation
14. Auxiliary Engines – components and operation
15. Marine Engineering redundancies
16. Mechanical and wear down of 4 and 2 stroke engines and failure analysis

17. Marine Engine Compression, Valves and Timing
18. Condition Based and Preventative maintenance scheduling
19. Piston and Bearing - lacquering and wearing of engine components
20. Fuels, oils and Low Sulphur fuels
21. OEM, Turbo servicing and failures
22. Marine Engineering service and non-serviceable replacement components
23. Propulsion, Fuels and fuel system problems
24. Lubrication oil systems
25. Bilge, ballast, Fire and deck wash systems
26. Marine engine - Mechanical Parts and Procurement
27. Corrosion
28. Vessel Machinery and Electrical systems
29. Rod and Piston damages and rings
30. Exhaust and intake valves
31. Crank shafts, Timing Chains, Springs and Rockers
32. Mechanical Damage from unusual sources
33. What can you learn from the external appearance of failures?
34. Propulsion systems, Shafts, Stern tubes and bearings
35. Gear box and tooth failures
36. Exhaust, inlet and valves in 4 and 2 stroke general arrangements
37. Marine Engine Checklists, Glossaries, Marine Engineering Terms and Vulnerabilities
38. LNG/Electric and Diesel Fuel and Petrol driven mechanical operations and mechanics
39. Marine Engine system - Checklists and Troubleshooting
40. How we can mitigate and prevent future defects, preventative measures and failures
41. Learn about Dynamic Positioning Systems and equipment

How will this Training Course be presented?

With instructor lead virtual online learning, the training methodology will incorporate both theory and skill training components, utilizing both traditional lectures, as well as hands-on exercises, group discussions and extensive case studies. Students are also trained in the technical operation, construction, configuration and operation of propulsion and auxiliary systems, stern tubes and shafting arrangements.

Participate with other students and the instructor in Factual - Real Case Studies which are broken down and exposed in relation to failures with individual case studies. The course is designed for participants with a limited knowledge of engine design and operation. The lecturer uses factual case studies and exercises along the way to cement participants' newly acquired skills and help them apply them to real situations.

Who is this Training Course for?

This course will benefit those with a background in, or a limited understanding of marine engineering principles and knowledge. This course is suitable to a wide range of professionals but will greatly benefit those searching for upskilling in the following disciplines:

1. Designed to introduce and enhance knowledge of marine related internal combustion engines, and the complexities of both 2 and 4 stroke engines, pumps and propulsion systems.
2. The operation, maintenance and repair of these engines and components depends on many factors – including wear down, poor repairs and diagnostic faults, poor maintenance, fuels and lubrication.
3. Results of IMO analysis of casualties and accidents show that in one third of all failures, that human error is involved.
4. Learn about construction, configuration and the operation of propulsion systems, stern tubes and shafting arrangements.
5. Factual - Real Case Studies are broken down and exposed in relation to 4 and 2 stroke engine failures with individual case studies each exceeding $150Million USD in the offshore industry.
6. The course is designed for participants with a limited [basic] to intermediate level of knowledge of marine engine design and operation including; back-office personnel, marine asset and ship spare part procurement, Planned

System Maintenance and Operational managers, underwriters and insurers entering the maritime industry, and Deck Officers in the sector includes;

7. Non-technical Engineers and professionals
8. Soft skill employees in the marine engineering space
9. Marine Engineers and Project Directors
10. Operational Managers of marine engineering teams
11. Marine Operation Managers
12. Senior Marine Engineers
13. Marine Assurance specialists
14. SIRE Inspectors
15. Marine Superintendents
16. Ship management and Fleet Operation managers
17. Marine Operational specialists
18. Port operational Superintendents
19. QHSE Managers
20. Marine Regulatory and Innovation specialists
21. Marine surveyors
22. Fleet Managers
23. Commercial Marine Managers
24. LNG Operators
25. OCIMF Inspectors Cat 1 (Oil/Chemical/Gas)
26. Marine Educational development and capability officers
27. Marine Engineering research and developers in new energy technologies
28. Marine Engineering R & D
29. Marine Asset Managers
30. Insurance professionals
31. Master Mariners
32. Logistics and cargo providers
33. Equipment and manufacturing soft skill employees wishing to advance into the maritime sector
34. Project Managers
35. Project Planners
36. Cost Estimators
37. Quality Assurance Managers
38. Contract Managers
39. Procurement Managers
40. Project Engineers
41. Discipline Engineers
42. Technical Assistants

Organisational Impact

The course will provide direct organisational benefits through improved marine engineering knowledge and practices. By applying the methods learned and practiced during the course, organisations will be able to:

- **IDENTIFY** cost effective maintenance strategies based on a detailed understanding of an marine asset's functional requirements, performance standards and conditions of use.
- **ASSESS** marine engineering schematics, drawings and design
- **DELIVER** technical mechanical and structural diagnoses of failures after thorough examinations of the engineering design, documentary material, physical and photographic evidence
- **TECHNICALLY EVALUATE** and provide 'evidence based' conclusions when encountering marine engineering failures
- **LEARN** the lessons from past failures from around the world associated with failures in the maritime industry
- **ENSURE** that the required levels of safety and in-service availability are achieved at minimal cost.
- **HAVE** the skill base and project experience as they apply to engineering maintenance of ships.
- **UNDERSTAND** the marine engineering functional definitions and performance standards

- **MASTER** the analysis of source data to identify trends and engineering failure characteristics
- **ADAPT STRATEGIES** and practices around the constraints due to a lack of understanding and synergies between marine engineers and non-engineering professionals or technical staff.
- **INCREASE EFFICIENCY** and reduce costs
- **ACHIEVE** objectives through accurate, marine engineering analysis and control
- **ENHANCE** your marine engineering team's knowledge base
- **DEVELOPE** key attributes required of a marine engineering professional
- **BECOME AN INDISPENSABLE MEMBER** in your organisational marine engineering team

Course Syllabus

DAY 1

0900 - 0920
Introduction

- Introduction to Virtual Learning
- Introduction of Lecturer and student attendees
- Outline of the 3-day course objectives, contents and schedule

0920 – 1020
Ship Machinery Systems Fundamentals

- Operation and maintenance practices
- 2 and 4 stroke cycles and LNG engine installations
- Diesel, Petroleum and LNG fuels
- Fuel systems
- Auxiliary generator sets [Genset] and Auxiliary engines
- Engine block – upper and lower crank case [bottom and top overhauls]
- Valves, Pistons and rods
- Combustion Cycles and problems
- Influence of fuel oil
- Piston Firing orders
- Carbon/soot and scoring
- Blowers and intercoolers
- Fuel injection
- Piston rings, retainers and liners
- Scavenging
- Heat exchangers
- Engine temperature indication systems
- Engine Cooling systems and operation
- Injector operation and Fuel Oil mix
- Overload and Overspeed

1020 – 1100
Case studies failures – Machinery, Propulsion and Shafts including shaft and design failures in excess of $125 Million USD

1100 – 1120
Coffee and Virtual Networking

1120 - 1220
Shafts, Stern tubes, Propellors and Bearings Fundamentals

- Propulsion and Gear Boxes
- Clutches
- Liners and shaft bearings
- Thrust Blocks
- Shaft bearings

- Stern Tube bearings
- Fresh water and Oil Supply
- Shafting
- Propellers fixed and non-fixed Controlled Pitch propellors
- Coupling/ and Gear box tooth failure
- Ship/Vessel steering and thrust
- Lubrication and friction - Corrosion and fatigue HFO
- Late maintenance and OEM service
- Main Engine Turbo and Super chargers how do they work.

1220 - 1300
How do the internal mechanics of an internal combustion engine operate and fail?

- Compression within bores
- Ignition and timing
- Chains and belt driven mechanisms
- The 2 and 4 stages of pistons and cylinders
- Exhaust and compression operations
- Timing failures
- Fuel stability and low fuel viscosity
- Hoses and clamps
- Power head arrangements for 2 and 4 strokes
- EFI and fuel delivery
- Valves and springs for exhaust and air entry
- Effect of compression and ignition
- Manifolds and gaskets
- ECU on 4 and 2 stoke engines
- 4 and 2 stroke engine seals and failures
- Pistons
- Rod assembly
- Bearings and rings

1300 – 1400
Luncheon and Virtual Networking

1400 - 1430
Diesel and Electric installations

- Pistons/Liners/Bores/Bearings and journals
- Marine Hydraulic and fluids
- Failures and Prevention measures
- Forces and stress

1430 -1500
Main OEM manufacturers –

- SULZER/MAN/WARTSILLA/B & W/CATERPILLA and others
- Managing the engineering investigations
- Trouble shooting

1500 - 1545
Pumps and Pump Systems

- Types
- Operation and maintenance practices
- Newtonians laws and principles
- Turbulent flows and rates
- Marine Engineering - Fluid mechanics
- Fluid Technology
- Causes, Failures and prevention
- Auxiliaries
- Trouble shooting

1545 – 1600
Coffee break and Virtual Networking

1600 - 1700

Ship Fuel Oils, LNG Bunkering, Lubrication and treatments

- Fuel oil
- Operation and maintenance practices
- OWS
- LNG Bunkering
- Lubrication Oils
- HFO
- Purification
- Sludging
- Exhaust and Emissions
- Poor Bunkers - Trouble shooting, Testing and Failure's - prevention

<u>TROUBLE SHOOTING WORKSHOP</u> – AN OPEN FORUM TO DISCUSS AND DETERIMINE STUDENT SPECIFIC COMMON FAILURES WITH AN EMPHASIS ON MAIN AND AUXILLARY ENGINES AND FUEL.

End of Day 1

0900 – 1000
Marine Engineering – Testing and Failure Analysis

- Controlled Pitch Propellor Functions, Operations and Mechanics
- Propeller mounting
- Design and Latent engineering failures
- Installation failures shafts
- Mechanical properties and testing
- Vessel performance

1000 - 1100
Corrosion and prevention

- Care and Maintenance
- Galvanic corrosion and electrolysis
- Stress corrosion
- Seals and oils
- Design and engineering installation practices
- Trouble shooting

1100 – 1120
Coffee Break and Virtual Networking

1120 - 1145
Bow Thrusters

- Failures
- CPP
- Care and Maintenance
- Seals and oils
- Design and engineering installation practices

1145 - 1210
Visual and non-Visual Inspections

- Other types of inspection NDT and DT
- Design and engineering installation practices
- Magnetic particle/Dye penetrate/UT

1210 – 1300
<u>TROUBLE SHOOTING WORKSHOP</u> –
Case Study - Ship Marine Engineering Materials, Parts, Inspection and Investigation

1300 – 1400
Luncheon break

1400 - 1500
OEM and Failures

- Internal Wear down and monitoring to prevent
- Condition loading principles
- Material Testing
- Marine Systems and machinery design

1500 - 1545
Trouble shooting for Marine Engineers and Project Managers

- Periodic Prevention measures
- Vessel Performance
- Aux engines
- Main engines
- Engine components
- LNG and Diesel/electric Engines
- Petrol Engine
- What happens internally
- How is power produced
- The effectiveness of 2 and 4 stroke engines and why
- The efficiency of 2 and 4 stroke engines and why
- What are the differences
- Crank shafts
- New Fuels in the Marine Industry LNG/Bio/Diesel/Diesel-Electric. – How do they all work?
- Strokes and forces
- New developments in the Marine Engineering field from around the world.

1545 – 1600
Coffee break and Virtual Networking

1600 – 1700
CASE STUDIES - How to prevent and identify Hazards regarding 4 and 2 stroke main and auxiliary engines aboard vessels.

CASE STUDIES - How to prevent multimillion $USD failures to 4 and 2 stroke engines due to poor maintenance practises and condition monitoring procedures.

End of Day 2

0900 – 0930
Fuel and Vessel efficiencies (Marine Engineering - Ship Construction and New Technologies)

- New ship design and Marine Manufacturing technologies
- Fuel efficiencies
- LNG and ships fuel
- Low Sulphur Fuels
- Retro fitting

0930 – 1000
Dynamic Positioning and New Advances

- Competencies and safety zones
- Training and Classification Types
- Manoeuvring and operating systems
- Sensory components and Electrical control systems
- Power and propulsion systems
- Redundancies

1000 - 1030
Marine Engineering Regulatory Requirements

- Objectives
- MARPOL
- IMO
- LNG Fuel Codes and Standards
- STCW
- Vessel classification

1030 - 1100
Marine Engineering Inspection - Check Lists

- Engineering
- Human factors
- Survey requirements.
- Condition of vessels hull and machinery.
- Defects and efficiency.
- Mechanical engineering - machinery survey procedures and checklists.

1100 – 1120
Coffee Break and Virtual Networking

1120 - 1200
Ship Electrical Systems Fundamentals - Inspection and Investigation

- Accidental causes a fire on board ships.
- Classification of fire causes.
- Chemical sources, material subject to spontaneous ignition - ships
- Materials, Cargo, Electrical heat energy
- Faulty electric circuits and equipment, replacement parts.
- Fuses, exposed lights by the type.
- Fixtures, motors and engine rooms leaks in fuel Systems.
- Welding in burning operations and other energy sources.
- Liquids and gases.
- Trouble Shooting
- Electrical wiring malfunctions.

1200 – 1300
Marine Engineering – Mechanical and Electrical Energy

- Fuses, exposed lights by the type.
- Fixtures, motors and engine rooms leaks in fuel Systems.
- Welding in burning operations and other energy sources.
- Mechanical energy.
- Liquids and gases.
- Electrical measurement
- Resistance and impedance
- Insulation resistance and 'Megger test'
- High voltage testing
- Electrical wiring malfunctions.
- Short circuitry
- Spark, wiring and fuses

CASE STUDIES – Mechanical and Electrical failure and diagnosis.

1300 – 1400
Luncheon

1400 – 1430
Marine Engineering – Equipment, Rigging and Hardware.

- Spares
- Wires and Tows
- Testing
- Shackles and failures
- In Service Inspections
- Service Leak Testing
- Hose Ops and Vessels Procedures
- Color coupling indexes
- Operational risk profiles
- Inspections and Audits – Rigging
- Inspections and Audits – Wire Ropes
- Inspections – Handling and Chains
- Inspection - Shackles and hardware

1400 - 1430
Fundamentals of Ship design, Naval Architecture and Engine performance - How it affects propulsion? What does it all mean?

- Introduction to Ship Naval Architecture
- Forces
- Centre of gravity
- Movement and stability
- Hydrodynamics
- Ship motion and vibrations
- Intact stability
- Damage and stability
- Degrees of freedom
- Systems and monitoring
- Example of diagrams of forces and degrees of freedom

1430 - 1530
Machinery Failure Prevention for Superintendents, Marine Engineers, Surveyors and Offshore Project Managers

- Periodic Prevention measures
- Vessel Performance
- Aux engines
- Main engines
- Corrective actions aimed at promoting reliability
- Engine components

CASE STUDIES – Effectiveness and efficiency of low sulphur fuel and LNG alternatives.

1530 – 1545
Coffee Break and Networking

1545 - 1630
Marine Engineering – Condition Based Monitoring and Planned Maintenance Systems

- Condition Based Monitoring
- Condition Based Monitoring Equipment
- Condition Based Systems and Methodologies
- Trend Analysis and Reference Values
- Reference Conditions and base line data
- Maintenance intervals and measurement records
- Evaluation of progress and extent of deterioration of mechanical systems
- Cost benefit analysis of Condition based monitoring
- Fatigue
- Vibration
- Balancing
- Control mechanisms
- Tools and equipment

1630 – 1700
Machinery and how to prevent costly failures

- Discuss planned maintenance systems
- Discuss Trend analysis
- Analysis of Condition monitoring technical CME
- OEM Main Engine component failures relevant to engine performance

Note:
(1) There will be a Question and Answer throughout the duration of the sessions and after each module.

1700 - Course Concludes

About the Marine LNG Institute - Course Director [Marine Engineering Fundamentals]

A former Chief Engineer, Vessel Fleet Superintendent [Engineering], Classification - Engineering Surveyor [GL and ABS], PMA Surveyor and IMO Engineering Class advisor. With over 25 years of experience in Marine Engineering critical incident to Statutory Government bodies, Multinational corporations and marine Insurers worldwide including; BHP Australia Pty Ltd, Solstad Shipping, Rickmers Shipping, Offshore Marine Service Alliance, Chevron - Oil and Gas, PMA Singapore, Petronas, Maersk Shipping, China Shipping Lines (CSL), Icon offshore Malaysia. His primary roles and expertise feature strongly in matters involving all ship machinery and engine failure investigation, propulsion/shafts, Main and Auxiliary system and component integrity and Diesel engine failure, vessel survey IMO safety compliance, G.A marine insurance claims, cargo handling equipment, maritime occupational health and safety, and vessel statutory surveys and audits.

From a marine engineering perspective, he has worked aboard a large variety of vessel classes including: Multi-Purpose Self loaders, Ro-Ro, Cruise liner Class, Panamax, Container and Combo -Heavy lift Ships. His previous experience also includes Technical Engineering Inspections of existing ships as per Class, Statutory and International codes. Compliance of Class, Standards, and Flag State Survey reports included: Dry Cargo, Self-Loaders, Ro–Ro, Heavy Lift, Container, Cruise Ship Class, Bulk Carrier and Multi- purpose vessels.

His experience also includes Forensic Engineering Material and Component Surveying, Technical Inspection of ship maintenance periods and preparation of vessels for periodical surveys. Currently consulting to, and is statutory appointed by European National Flag States and as a Marine Engineering Flag Survey Inspector/Examiner.

Marine LNG Institute - Alumni Testimonials:

Lecturer is very knowledgeable and conduct himself and the course very well. A very interactive communication with clear and easy to understand, on machineries like switchboard, engine control room, ballast systems, fire system, portable water system, cargo pumps, propulsion.
Daewoo Technologies – South Korea

Hybrid technology and regulations and current topics in marine industry such as renewable energy...great. Lecturer really expanded on marine engineering technologies also very good.
Ship management and Procurement – Wilhelmsen Vessel Management

"*Great expert, very professional and a key Lecturer. Only 10 students on the course allowed is great for asking questions in small groups of the Lecturer.*
Senior Base Manager – Icon offshore Malaysia

"*I'm going to go to do another of the informative courses. Very interesting and is well and truly a great Lecturer. Very informative.*"
Business Manager, Sembmarine International

"*I got so much out of it. From an Oil and Gas perspective, I have never been or listen to a world leading expert in this technical Oil and Gas - Maritime field.*"
Senior Manager, KSDC Brokers Singapore

"*I have done several courses and this one was the best I have attended so far. Very technical and informative, very approachable and professional.*"
Woodside Australia (Oil and Gas - Gorgon Project)

"*Excellent Speaker and held in high regard in the Oil and Gas industry. All the executive management got a great presentation and seminar over the three days, terrific.*"
KSDC Oil/Gas Brokers Malaysia

"*We learnt a lot about the current marketplace and 2019 – 2020 forecasts in Asia, Qatar and the Middle East. The need for this course is essential if you are engaged in the industry.*"

Chevron Gas and Oil [USA]

"*Useful and interesting. Topic related to my job scope."*
Inter-Continental Oils & Fats Pte Ltd

"*Instructor was good at presentation of the material. Topics are directly related to my current job scope. Case studies ensured equal and sufficient interaction and tested our understanding of the topics*"
Navig8 Asia Pte Ltd

"*Good case studies and knowledge from law perspective. Adequate number of participants*"
PT Chandra Asri Petrochemical Tbk

"*Lots of interaction between trainer & students. Informative on certain topics.*"
Nova Carriers (Singapore) Pte Ltd

"*Trainer is very experienced and knowledgeable. Coursework/material were adequately sufficient.*"
Total Oil Asia Pacific Pte Ltd

"*Speaker able to deliver clearly. Lots of case studies covered.*"
Ace Oil Pte Ltd