



SeaTALK Knowledge Maritime English Framework

A Source for Applying Phrases and Vocabularies for the Developing SeaTALK Content, Assessment Documents including Tests

Introduction

MarTEL Deck and Engineer Officer 'Knowledge' comprises of two knowledge-bases, namely, Navigation Knowledge (Nav-Know) and Marine Engineering Knowledge (Mar-Know). These are complemented by knowledge incorporated by the IMO auxiliary safety courses such as fire fighting as well as courses such as BRM, ERM and so forth. For MarTEL Knowledge for Senior Officers extend to IMO MARPOL, SOLAS, ISPS codes and regulation contained in ILO directives as well as the IMO's International Safety Management (ISM). The following are the summaries of:

1. SeaTALK Knowledge Deck Framework: Nav-Know
2. SeaTALK Knowledge Marine Engineering Framework: Mar-Know
3. ISM Code (2002)

1. SeaTALK Deck Knowledge Framework: Nav-Know

Navigational terms

The Earth; shape and compression, great circle, small circle, spherical angles and triangles, earth's poles, equator and meridians, latitude, parallel of latitude, prime meridian, longitude, D.Lat and D.Long, international nautical mile, position line, position circle, true course, rhumb line and departure, current/tidal stream, Estimated Time of Arrival (ETA), mean latitude; limiting latitude, composite great circle, Way-Points (WP), Meridional Parts (MP) and the Difference of Meridional Parts (DMP) Navigational calculations: eg. plane and parallel sailing, Mercator, great circle and composite great circle sailings

Charts and publications

Navigation and routing charts, sailing directions and chart catalogue, notices to mariners (eg. annual summary, weekly notices, cumulative list of notices to mariners), nautical almanac, tide tables, tidal stream atlases, admiralty list of lights; admiralty list of radio signals, International Maritime Organisation (IMO) ships routing guide to port entry and similar commercial publications, correction logs, navigational warnings, electronic chart display and information systems (ECDIS).

Position fixing, compass errors by transit; cross bearings and transits, to fix a position, the cocked hat, single position lines, the running fix, taking soundings to verify position, reliability of fixes, plotting Dead Reckoning (DR) and Estimated Positions (EP), course steered, log distance, log speed and time, leeway and estimated set and drift, water and ground tracks, variation and deviation.

Chart-work techniques

Passage plans; use of published routing instructions and guidelines (eg. IMO Ships Routing Guide, International Regulations for Preventing Collisions at Sea, Rule 10, Admiralty Chart 5500 Mariners Routing Guide), stages in making a passage plan (eg. the generation of passage plan waypoints),



following a passage plan, making a landfall, magnetic course to steer and Estimated Time of Arrival (ETA);

Tidal terminology

Tidal definitions (eg. chart datum, high / low water, height of tide, tidal range, spring and neap tides, Mean High Water Springs (MHWS), Mean Low Water Springs (MLWS), Mean High Water Neaps (MHWN), Mean Low Water Neaps (MLWN), heights of charted objects, drying heights); causes of tides (eg. Lunar and solar gravitation); significance (eg clearance/fouling, access to ports, loading/unloading of cargo)

Celestial Navigation

The solar system, celestial sphere, sextant, celestial sphere, hour angle, amplitude, chronometer, the Nautical Almanac, GHA, LHA and declination of Sun stars and planets, UTC, LMT, standard time and Zone Time, azimuths of celestial bodies, star diagrams, starfinder

Navigational Watch

Bridge Watchkeeping:

Regulations for Preventing Collisions at Sea and IALA Buoyage System A-B: Direction of buoyage, recognition of marks from shape, colour, topmark and light bridge watchkeeping procedures, vessel manoeuvres, magnetic and gyro compasses and steering systems bridge communications, manoeuvring procedures, monitoring the progress of the vessel, pre-planned track, navigation equipment, telegraphs, bridge control systems, proximity of icing, turning circles, stopping distance, Deadweight Draught and trim, Speed and rudder angle, transverse thrust, single, twin and controllable pitch and fixed propellers, under keel clearance, wind, current and tidal stream, squat and shallow water effects; vessel/vessel and vessel/bank interaction, interaction between tugs and vessels, dangers of girding, pitching, pounding, rolling, synchronous rolling, racing and broaching to, manoverboard.

Passage Planning:

Intended passage, passage plan, simulated passage, pollution prevention, currents and tidal stream information, climatological factors and weather routeing, landfall position, loadline, fuel and neaping, berthing, anchoring, in harbour suitable anchorage, under keel clearance and air draught, traffic separation and routeing schemes, VTS, contingency plans, engine failure, steering gear failure, extreme weather conditions, malfunction of navigational equipment, safe water areas, to maximise sea room, alterations to the passage plan, adverse weather condition, weather routeing, tropical revolving storm, optimum track and speed. *SOPEP, MARPOL.*

Bridge Management including Ship Handling:

Propulsion systems and configurations, steering devices, thrusters, trim, list, draft, shallow water, bow and stern wave, interaction, weather and tidal conditions; manoeuvring data, stopping distances and emergency stops, turning circles, speeds at various revs per minute, critical and minimum engine speeds, berthing, unberthing and anchoring, turning on an anchor, dragging anchor and countermeasures, weighing and leaving the anchorage) Routine and emergency circumstances: routine manoeuvring procedures (e.g. picking up and dropping a pilot, operating in the vicinity of off-shore installations, operating with tugs and small craft, operating with helicopters, heavy weather, narrow channels, in or near ice, in or near Vessel Traffic Services (VTS) and Traffic Separation Scheme (TSS)); emergency manoeuvring procedures (e.g. man overboard, launch and recovery of survival/rescue craft, fire, flooding, collision, shift of cargo, beaching, loss of propulsion and/or steering, emergency towing, use of anchor in emergency, Search and Rescue (SAR) situations), off-



shore installations, positive reporting of readiness, cargo security, watertight integrity, pre-departure briefings, security of cargo and stores, stowaways, crew and passenger lists, International Safety Management (ISM) code checklists, passage planning and bridge preparation, ship stability, port clearance.

Emergency Response and Communications

Emergencies:

Malfunction or failure of bridge equipment: types of alarms, navigation lights, navigation aids, compasses, autopilot, steering systems, bridge control, engine telegraph); procedures for calling the Master and complying with orders; communicating with others; safety of the vessel, contingency plans: role of the Officer Of the Watch (OOW), shipboard contingency plans, standing orders, company instructions and guidance; main engine failure, steering gear failure, man overboard, fire, dragging anchor, collision — imminent or actual, stranding and grounding flooding; regarding stability; parting of lines and tow ropes; security issues (eg piracy, terrorist activity, armed robbery); abandoning ship, anchoring terminology; safe use of machinery used when anchoring; safety precautions when securing the vessel at anchor; anchoring with a single anchor; factors affecting the amount of cable to use; communications during anchoring operations

Distress signals:

Distress, urgency and safety signals: regulations and codes of practice (eg annex IV international regulations for preventing collisions at sea, Safety of Life at Sea (SOLAS), International Aeronautical and Maritime Search and Rescue manual (IAMSAR), annual summary of the Admiralty Notice to Mariners — notice number 4); indications of ships in distress; statutory distress signals (refer to the International regulations for preventing collisions at sea (IRPCS) — annex IV); Emergency Position Indicating Radio Beacons (EPIRBs) and Search And Rescue Transponders (SARTs); radio watch for and reception of distress signals; signals used by sunken submarines and aircraft; casualties at sea (refer annual summary of Admiralty Notices to Mariners — section 4); radio telephone (RT) distress procedure; instructions to lookouts, technique of homing on radio signals Search and rescue: Global Maritime Distress and Safety System (GMDSS); action by assisting ships; use of the IAMSAR manual; follow a contingency plan; immediate action (eg actions to take when proceeding to the area of distress; on board preparation); aircraft casualties at sea;

Signalling:

Morse code by light, morse signalling procedures; encoding and decoding messages; international code of signals: code flags, distress signals; use of the phonetic alphabet; Language difficulties: sources of phrases and codes to aid communications (eg International Maritime Organisation (IMO), standard marine communication phrases, International Code of Signals.

Electronics Navigation

Electronic Systems of Position Fixing and Navigation; Echo Sounders and Speed Measurement, Magnetic and Gyro Compass, Steering and Control Systems and 'Speed Distance Measuring-SDME , Electronic Systems of Position fixing (SATNAV, GPS and DGPS

Magnetic and Gyro Compass:

Magnetism, natural and artificial magnets, magnetic flux, electro- magnetism, magnetic field strength, ship's magnetism, deviation and variation, magnetic compass repeaters, gyroscopic principles, gyroscopic inertia, precession and earth rotation, the rates of tilting and drifting of spins, the north-



seeking gyro and a practical gyrocompass , follow-up system, gimbals, pendulums, damping and damping in tilt.

Steering Control Systems:

Steering control systems, fin stabilizer steering gear system, remote steering control systems, steering gear and rudder arrangements, rudder forces, actuator working principles, automatic steering, auto-pilot system, phantom rudder , an adaptive autopilot, change-over from manual to automatic, alarms and monitoring aids for automatic pilots.

Echo Sounders, Speed Measurement and Speed Distance Measurement:

Echo sounder operation, ultrasonic waves in sea water, sources of noise, interference, aeration, false echoes, salinity, temperature and pressure on velocity of sound, transducers including closed hull and pierced hull types, marine echo-sounder, range and phase, sensitivity, gain, chart datum, suppression. Speed(logs) and distance measuring equipment, Doppler log, observer on pitch, siting of transducers, ground and water tracking.

Electronic Systems of Position Fixing and Navigation:

(SATNAV,GPS and DGPS), propagation of radio waves, waveforms, velocity, wavelength, frequency, amplitude, cycles, radiation patterns, signal to noise ratio, reflection, refraction and absorption at atmospheric layers, ground waves, direct waves and space waves, phase coding, pulse modulation, amplification, hyperbolic navigation systems; resolve ambiguity, accuracy, pseudo-range, Dilution of Precision (DOP), Datum, UTC, wide area and local area augmentation.

Radar & Automatic Radar Plotting Aids (ARPA), ECDIS (Electronic Chart Display Information System), AIS (Automatic Identification Systems), superimposition, automatic track-keeping, AIS transponders, critical echoes, true and relative vectors, exclusion areas and trial maneuvers, tracking capability.

Communications and GMDSS

The Maritime Mobile Service, The Maritime Mobile -Satellite Service, Digital Selective Calling (DSC), Narrow Band Direct Printing (NBDP) and Telex Over Radio (TOR) Systems, Inmarsat Systems, Global Maritime Distress and Safety Systems (GMDSS), NAVTEX, Emergency Position Indicating Radio Beacons (EPIRBs),Search and Rescue Radar Transponder (SART),Search and Rescue Operation (SAR),VHF Radio Installation, MF/HF Radio Installation, Survival Craft Radio Equipment, Reception of Maritime Safety Information (MSI), RCCs.

Meteorology

Meteorological observing methods:

W.M.O. codes, Aneroid and precision aneroid barometers, Barograph, Mason's hygrometer, Marine screen and whirling psychrometer, Beaufort Scale.

Meteorological processes:

Heating and cooling of the troposphere, Variation of surface temperatures, Environmental Lapse Rate and its variation including temperature inversions, Pressure, units, isobars, pressure gradient, pressure



gradient force, Coriolis force, cyclostrophic force, friction, Geostrophic wind scale, Buys Ballot's Law, Land and sea breezes, katabatic winds, cloud and precipitation, the causes of reduced visibility, latent heat, adiabatic temperature changes, cloud decay, types of fog and mist, and the development of haze, Formation of dew and frost, Weather and ice bulletins, surface and upper air synoptic weather charts, prognostic wave height charts, ice charts, weather routing, formation and decay of icebergs,

Weather:

Synoptic patterns and air masses, Frontal depression, depression, Non-frontal depressions and non-frontal troughs, anticyclones, ridge of high pressure, Polar, Tropical, Arctic and Antarctic air masses, Monsoons, Tropical Cyclone (TRS)

Ship Stability***Hydrostatics:***

Mass, volume, density and relative density, Archimedes Principle, Hydrostatic data, displacement volume, displacement, buoyancy, waterline length, breadth, draught, LBP, A_w , C_w , C_B , and freeboard, Load-line, Dock Water Allowance, Use of Hydrometer, Displacement, Deadweight and TPC Tables, draught marks.

Static stability:

Centre of Buoyancy, Centre of Gravity, Initial Transverse metacentre, Righting Lever, Righting Moment, Stable, Neutral and Unstable Equilibrium at small angles of heel, GZ curves, Stiff and Tender Vessels, Angle of Loll, stability, trim, draught and list: stability information, inclining experiment, bilging, the Grain Code, shear force and bending moments

Transverse stability:

G of loading, discharging and moving weights, List and Loll, methods of correction, free Surface, dangers and effect at small angle of heel, effect of tank subdivision and density

Longitudinal stability:

LCF, LCG, LCB, Trimming Moment and MCTC, the inter-relationship of draughts, trim, weight and their positions

Ship Construction***Ship structure:***

Ship's geom-displacement, deadweight, LOA, LBP, waterline length, Lloyd's length, moulded breadth and depth, camber, sheer, rise of floor, beam, flare and rake, structure liable to sustain damage due to heavy weather, vibration, shifting cargo, grounding or collision, framing systems - transverse, longitudinal and combined systems, bulkheads - swedged, corrugated and plain showing connections to adjacent plating, structural arrangements : the upper deck and hatchways - bulwarks, rails freeing arrangements, angular deck corners and rounded sheer strakes, hatch coamings, covers and securing, hatchboards, pontoons, steel WT covers, deep tanks and tanker hatchways, water and weather-tightness. Watertight integrity and reserve buoyancy, watertight doors, ports, windows, deadlights and doors, structure of tanks - double bottoms, sides, wings and peaks, the siting and securing of air and sounding pipes, bilge and ballast piping systems from tanks/holds to engine rooms including non return valves, sea chests and mud boxes. Bending of beams, bending moment and sheer force, tensile and compressive stresses in beams; load diagram, shear force diagram, bending, moment diagram

***Ship types:***

Gas and Chemical Tankers, Ro-Ro ships, Container Ships, Bulk Carriers, Passenger Ship, Supply and Stand-by vessel, Surface effect vessels, High Speed Crafts, Tugs

Structures and Maintenance***Vessel structures:***

Loadlines, codes for the construction of specialised vessels; compartments and magazines containing explosives (i.e. international maritime dangerous goods code Class 1 (IMDG Class 1)) Damage limitation, ventilation systems, bilge and pumping arrangements, fixed fire fighting systems, watertight doors and valves, classification of bulkheads and fire doors, strengthening for ice.

Maintenance:

Materials and repair processes: steel, non-ferrous alloys, glass-reinforced plastics (GRP) and plastics, ceramics and cement, timber. Processes: annealing, normalising, welding, galvanising, bonding. Maintenance equipment and materials: consumables, paints, chemicals, cleaning agents and lubricants; maintenance equipment and machinery; Corrosion and failure: material degradation (e.g. brittle fracture, fatigue, creep, chemical and electrolytic action, stress corrosion, biological and photo-degradation of plastics); destructive and non-destructive testing methods. Maintenance routines to prevent structural failure: planned maintenance systems; methods of maintaining different parts of a vessel's structure (e.g surface preparation; coatings and cathodic protection); operational and maintenance requirements of safety equipment (eg fire fighting appliances (FFA), life saving apparatus (LSA))

Hull fittings and equipment:

Dry-docking: preparation of a dry-dock specification; preparation of vessel to enter dock; planning and management of work; crew and service arrangements. Preparations for surveys: hull and machinery; lifting appliances; loadlines; safety requirements

Cargo Handling***Dry cargo:***

Loading of dry cargoes: stowage and carriage of cargo (eg dry, refrigerated, unitised, containerised, Ro-Ro and bulk cargoes), relevant chapters of the code of safe working practices for merchant seaman, merchant shipping (M) notices relating to cargo handling and carriage; cargo planning and interpretation of cargo plans; cargo calculations (eg volume, weight, height, stowage factor, broken stowage); separation and marking of cargo; cargo documentation; preparation and inspection of cargo compartments for loading Cargo handling: purpose and method of dunnaging cargoes; approval, maintenance and safe use of cargo handling equipment (eg winches, derricks, cranes, hooks, slings, approved devices for specialised cargoes, fork trucks, other mobile equipment) Cargo compartment access equipment: safe procedures for operating equipment (eg hatches, hatch covers, internal ramp ways, side/bow/stern doors and ramps); procedures for stowing and securing and international cargo handling codes (eg containers, Ro-Ro, refrigerated, deck, bulk, including coal and grain, packaged dangerous goods, break bulk) Cargo care on passage: eg ventilation and humidity control, monitoring of cargo condition.

***Gas, liquid and chemical cargo:***

Loading, stowing and carrying: stowage and carriage of gas, liquid (including oil and multi-grades) and chemical cargo and related ballasting operations; common pipeline systems, cargo venting systems and pressure/vacuum valves, heating and cooling systems; tank and line cleaning. Dangers and safety procedures: tanker safety and the dangers associated with handling gas, liquid and chemical cargos such as, the flammable diagram, ignition sources; static electricity causes, danger and prevention; toxic effect of liquid, gas and chemical cargo Testing tank atmospheres: purpose, use and limitations of instruments (e.g. explosimeters); procedures for using inert gas systems Cargo handling and ballast systems: precautions and procedures for cargo handling (e.g. multi-grades); methods, procedures and importance of tank and line cleaning; methods of ballast management (eg segregated ballast tanks (SBT), importation of non-indigenous species as a result of scooping up marine life with the ballast water) Methods of cargo measurement: eg ullages, soundings, density, temperature.

Deck watch:

Deck watch alongside and at anchor: duties of the deck watchkeeping officer (eg general safety and security, supervising vessel operations, liaising with shore personnel, supervising deck crew on deckwatch, gangways, moorings, fire patrols, accident and pollution prevention); procedure for entry to enclosed spaces and permit to work systems; emergency procedures (eg fire and accidents); preparation of the vessel for sea and the onset of adverse weather Safe access to the vessel: gangways, accommodation ladders and other approved systems (eg pilot hoists and ladders); safe movement on board ship; effects of tide; changes of draught and trim; the effects of wind, waves, swell, and passing vessels

Prevention of marine pollution during cargo operations:

Current requirements: marine pollution (MARPOL) convention, precautions and procedures: pro-active and re-active policies; during vessel operations; bunkering; hazardous substances onboard; cargo waste and tank residue disposal; noise and clean air.

Cargo and Passenger Operations***Dry cargoes, stores and equipment:***

Safety procedures: the code of safe working practice for seamen (COSWOP); entry into enclosed spaces; merchant shipping (M) notices, voyage: voyages through different load line zones, calculations of cargo, fuel, fresh water and stores on board; cargo weight and volume, stowage factor, broken stowage; stowage and securing requirements, coal and grain, packaged dangerous goods, break bulk, stores and equipment Pre-loading inspection: survey and inspection of cargo; port rotation on stowage; suitable cargo plans, use of loading/tally sheets; draught surveys; cargo space preparation, heavy lift operations; damaged cargo; contingency planning; monitoring and care of cargo on passage.

Gas, liquid and chemical cargoes:

Hazards and safety: flammable diagram; to prevent static electricity; toxic effect of cargoes; testing tank atmospheres Cargo capacity and planning: international safety guide for oil tankers and terminals (ISGOTT); International Chamber of Shipping (ICS) tanker safety guide (Chemicals) and codes for ships carrying liquefied gases in bulk; cargo planning (eg quantity, disposition, tank capacities, calculation of ullages, expansion allowances, volume calculations); inert gas and vent systems (e.g. function of each component, operational procedures during tank cleaning, loading and discharge, vapour emission control) Cargo operations: comparison of pipeline systems; loading/discharge/ballast/de-ballast operations, single and multi grade cargoes; ballast management;



pollution prevention; shipboard oil pollution emergency plan (SOPEP); double-hulled ships; combination carriers, liquid petroleum gas (LPG), liquid natural gas (LNG); contingency planning

Passenger operations:

Passenger operations: embarkation and disembarkation procedures, lists and muster points, safety drills, pre-sailing announcements); systems for dealing with and resolving complaints (e.g. customer care, media awareness); deaths on board. Passenger cargo: arrangements for hazardous cargo, vehicle loading arrangements and vehicle deck safety; control of passenger movements about the vessel and on vehicle decks; baggage handling systems; control of access and in-port security arrangements; on-board security at sea Passenger comfort and safety: heavy weather avoidance, manoeuvres to minimise motion and advice to passengers; watertight door and other closing appliance drills and procedures; special requirements for the organisation of management systems on large-crewed vessels Passenger planning: e.g. passenger list, passengers with special requirements, vessel facilities, port facilities

Safety at Sea***Emergency:***

Emergency and damage control plans: contingency plans, standing orders, company instructions and guidance); protection and safety of persons on board and cargo; initial actions and response; lines of communication, signals required); prevent environmental pollution and damage control; port of refuge; abandon ship, distress and medical, enclosed space rescues, main engine failure, steering gear failure, man overboard, fire, dragging anchor, security issues (eg piracy, terrorist activity, armed robbery). Damage control: eg imminent collision and collision, stranding and grounding, flooding, risk of injury to passenger/cargo damage, stability, pollution, parting of lines and tow ropes

Emergency and damage control procedures:

Emergency drills: evaluation of drills and feedback, reaction times, communication systems, International Safety Management (ISM) code; Marine Pollution Convention (MARPOL); Safety of Life at Sea (SOLAS) 1983 plus amendments, legal obligations; responsibility for safety of persons, emergency towing, re-floating, external assistance, use of own resources.

Search and rescue operations:

Obligation, responsibilities and actions, Search and Rescue (SAR) operations; International Aeronautical and Maritime Search and Rescue (IAMSAR) manual, annual summary of Admiralty Notices to Mariners — Notice 4); consultation with other stations, answering the distress; legal obligations; exemptions from answering a distress; log book entries Search planning and preparation: categories of distress incidents (eg coastal, ocean); abbreviations, terms and definitions used; communications (eg internal, external, verbal and non-verbal); co-ordination of SAR operations; designation of SAR mission co-ordinator (SMC) and on-scene co-ordinator (OSC), co-ordinated search; search patterns; drift, leeway and visibility; drift patterns, disabled vessels; rendezvous; a datum point, on board preparation; assisting ships; approaching the scene; radar search; arrival on scene; implement search plan; search and rescue aircraft; homing on radio signals; aircraft casualties. Retrieval of survivors, ditched aircraft, evacuation by helicopter. Termination of SAR operations: care and questioning/de-briefing of survivors; decision to terminate.



Maritime Security and Management

Shipboard Management

Personnel management:

Personnel management: senior officer as personnel manager, decision-making processes, monitoring performance indicators and measures, discipline and procedures, counselling and guidance, departmental and performance appraisals, discipline, counselling and guidance

Management:

Management principles and techniques: assessing resource requirements; personnel development, training programmes; personnel records; shipboard budgets; fixed and variable costs, expenditure profiles, budgetary variances,

Employment law, quality assurance and safety management:

Employment law: employment legislation; employment, merchant shipping acts, safe manning, hours of work, safety management and quality assurance legislation, human error, systems error, international safety management (ISM) code, Safety management systems, safety culture; risk assessment, safety audits, investigating incidents, safety committee.

Marine Law and Conventions

Law, codes and guidance:

Law, codes and other forms, international conventions and treaties; legislation, codes of practice and merchant shipping (M) notices; an overview of UK civil and criminal law; an overview of flag and port state control; shipping company regulations; penalties for non-compliance Record keeping: records for commercial and legislative purposes; confidential nature of records, recording methods (eg written records, automatic data recorders); importance of accuracy in record keeping

Ship and crew safety and operations:

Safety of ship and crew: law, codes, principles and procedures and other forms of guidance regarding life saving and fire fighting apparatus (LSA and FFA); an overview of International Maritime Organisation conventions (IMO) (eg marine pollution (MARPOL) and its annexes, Safety of Life at Sea (SOLAS), International Safety Management,(ISM)); relevant codes for maintaining a safe working environment on board ship (eg code of safe working practice for seamen (COSWOP), reporting of accidents and dangerous occurrences, Control of Substances Hazardous to Health (COSHH) regulations, safe navigational watch, safe deck watch); organisation and management of the crew; legal and organisational framework for handling conflict; overview of employment law relating to the individual Anti-pollution legislation: MARPOL convention, annexes and related legislation (eg current merchant shipping prevention of oil pollution regulations); company policy and procedures for compliance with MARPOL; penalties for non-compliance

Personnel management:

Managerial roles and key responsibilities: facilities, human and physical resources manager; chains of command and responsibility aboard ship; culture of safety in the workplace, motivation, leadership, teamwork, delegation); inter-personal communication, group dynamics; equality of opportunity (eg



race, culture and gender issues), role of appraisal, counselling and discipline, identifying stress in self/others and the management of stress; conflict and conflict resolution; referral to counselling.

Agreements and conventions:

Certification, load-lines, Safety of Life at Sea (SOLAS), marine pollution regulations (MARPOL), health regulations, safety of ship, passengers, crew and cargo), national legislation for implementing international agreements; conditions for issuing, validity, extension and content of statutory certificates and documents

UK and international maritime legislation:

Principles of the laws of contract, tort and agency; liens; arbitration; UNCLOS III; statutory and other records including the Official Log Book (OLB) and Oil Record Book (ORB); legal responsibility of the master (eg distress, collision, encountering navigational hazards, pollution, salvage, towage, pilotage) Ship operations: survey requirements (eg flag state surveys, classification, port state control surveys); record keeping and the collection of evidence

Commercial law:

Safe handling, stowage, securing and transport of cargoes such as, Carriage of Goods by Sea Acts, contracts of carriage of goods); charter party types, laytime, clauses, rights and obligations; Bills of Lading; carriage of deck cargo Marine insurance: coverage of the Marine professional and indemnity (P & I) clubs and associations; commercial institutions (eg Lloyds, Baltic Exchange); general average, York-Antwerp rules; safe port; noting protest and extending protest Port procedures: procedure on arrival and departure to meet commercial laws and legislation (eg cargo loading and discharge to be undertaken)

Maritime Manager-ship

Awareness of Shipmaster's Commercial Knowledge:

Ship as the carrier, responsibilities of the carrier, Charter Party, Commercial documentation, general average, insurance of cargo

Ship Technical Management:

Master's handover documentation, Classification of the ships, Types of survey, Pollution control
Master's additional handover documentation, Registration, Official publications and records
Master's duties; ship's arrival/departure to and from port, Master's reportable incidents, Legal requirements of Ship Masters, Quality assurance

Marine Engineering Systems

Marine power plants:

Diesel plant, Diesel propulsion and associated systems, Critical aspects and operational limitations of diesel engine operations

Steam turbine plant:



The layout of steam turbine and associated plant, Critical aspects and operational limitations of boiler and turbine operations

Gas turbine plant:

The layout of gas turbine and associated plant, Critical aspects and operational limitations of gas turbine operations

The transmission of power to the propulsion system:

Factors affecting fuel consumption, Fuel consumption calculations, Conservation of fuel, Propeller pitch and slip

Auxiliary machinery:

Auxiliary boilers, Distillation and freshwater systems, Pumps, Refrigeration and air conditioning systems, Ventilation, Sewage treatment plant, Oily water separation and oil filtering, Incinerators, Electrical power generation and distribution, Stabilisers

Steering and manoeuvring systems:

Ram and rotary systems, Telemotor and transmission system, Auxiliary and emergency steering systems, Thrusters, Relevant regulations

Control systems:

Marine engineering terms, *Terms in common use consistent with use in UK regulations*, the concepts of control systems, *Open and closed loops and their components*, *Types of control action*

Practical shipboard applications:

Data loggers, Mimic diagrams, Analogue and digital displays

Bridge control:

Principles of bridge control, including fail safe, fail run and safety interlocks for: Slow speed diesel engines, Medium speed diesel engines fitted with controllable pitch propeller or reversing gearbox, Steam turbines with associated boilers, Gas turbines, Thruster systems, Interchanging bridge and engine room control, Requirements for plant monitoring and alarm systems for UMS Operations, Integrated bridge systems

Bridge Team Management

Voyage Planning:

Detailed passage plan in coastal, confined and/or pilotage waters, berthing/un-berthing plan, vessels particulars; operational restrictions; hazards; weather; traffic density; international and local regulations.

Risk awareness:

Risk assessment for each leg of a planned voyage, proactive measures planned to minimise or eliminate risk.

Bridge team management:

Two-way flow of knowledge between bridge team members, continuous monitoring of equipment, communications, emergency and non-routine situations, over-reliance on a single source



2. SeaTALK Marine Engineering Knowledge Framework: MarEng-Know

Trim and Stability

Stability at small angles of heel: centres of buoyancy and gravity, metacentre, Metacentric height and the criteria for stability; changes of stability due to changes of loading

Trim: changes of trim with changes of loading

Stability at large angles of heel: limitations of metacentric (small angle) theory; curves of statical stability; changes of GZ curve and angle of heel due to changes in loading; changes of GZ with shipform

Watertight sub-division and the effects of compartment flooding

Watertight sub-division: rules governing sub-division

Effects of compartment flooding: change of draught and stability due to bilging; heel and trim caused by bilging

Ship Construction

Ship construction: define ship terminology; basic ship construction and functions of structural components; the design features of different ship types.

Forces on ship structures

Static forces: weight and buoyancy distribution; load diagram; shear force diagram; Bending Moment diagram.

Dynamic Forces: difference between static and dynamic forces.

Stress in ship structures: how stress is calculated; how stress is measured; stress (strain) gauges.

Resistance to ship motion, propellers, powering estimates and fuel consumption

estimates

Ship resistance: techniques for identifying ship resistance; resistance components

Powering: power estimates; identification of power losses; fuel consumption estimates; fuel and admiralty coefficients.

Propellers: basic propeller terminology; relationship between indicated power, shaft power, delivered power and thrust power.

Machine tools

Machine tools: a range of machine tools and their applications (eg centre lathes, vertical and horizontal milling machines, cylindrical and surface grinders, centreless grinders, lapping, honing, planing and shaping machines, internal and external broaching machines, sawing machines, presses,



sheet and tube bending machines); types of drives (eg for lathes, milling machines and presses); relative motion between cutting tool and workpiece.

Work holding techniques: the six degrees of freedom of a rigid body with respect to work holding and jig and fixture design (eg the need for rigidity in design and build of machine tools, three and four-jaw chucks, use of centres, machine vices, worktable clamps, magnetic tables, etc.).

Tool holding: toolposts; morse taper shanks; Jacobs chucks; milling machine arbors; mounting and dressing of grinding wheels.

Machining operations

Components and geometries: component features typically associated with lathe work, milling, sheet metal forming and broaching. For example: Lathe work: rotational operations - diameters and face turning, taper turning, chamfers, radii, drilled holes and internal bores, deep holes, internal and external threads, grooving, knurling, parting off, roughing and finishing cuts, the purpose and use of cutting fluids Milling: prismatic operations - face milling, slab milling, profiles, pockets and slots, drilling, reaming, thread tapping, thread milling, counterboring, countersinking, roughing and finishing cuts.

Press work: sheet metal forming operations - blanking, piercing, drawing, bending, notching, cropping, use of progression tooling; finishing operations.

Broaching: internal and external - square and round holes, splines, gear teeth, keyways, rifling and flat, round and irregular external surfaces.

Material cutting and forming processes

Tooling: choice and effects of tool geometries; choice of tool material; permissible depth of cut; types and consequences of tool wear; importance of clearance in pressworking operations; calculation of expected tool life.

Forces: theory of metal cutting; mechanics of chip formation; shearing mechanisms in press work; calculation of forces exerted on cutting/forming tool and workpiece during various operations; calculation of power required to perform specific operations; use of dynamometers and other condition monitoring/measuring equipment.

Speeds and feeds: calculation of speeds and feeds for turning and milling operations on a variety of workpiece features, sizes and materials (eg aluminium alloys, mild steel, tool steels, cast metals and alloys); relationship between cutting speed and tool life – economics of metal removal Produce components

Health and safety: issues related to machine tools, workshops and the production environment in general; responsibilities of the employer and employee under the Health and Safety at Work Act and other legislation; correct and approved use and operation of systems and equipment; potential hazards for given machine tools.

Principles of production: tool and work setting techniques; interpretation of specifications and engineering/production drawings; feature measurement (eg depths, diameters, screw threads, etc.).



Instrumentation systems

System terminology: accuracy; error; repeatability; precision; linearity; reliability reproducibility; sensitivity; resolution; range; span; zero drift; hysteresis **Sensors/transducers:** pressure (eg resistive, strain gauge, inductive, capacitive, semiconductor, ceramic, piezoelectric, LVDT); level (eg conductivity, capacitive, ultrasonic, radar, nucleonic, loadcells, radiometric, microwave, hydrostatic, sonar); flow (e.g. ultrasonic, Coriolis, vortex, magnetic, differential pressure); temperature (eg resistance, thermocouple, radiation pyrometers); displacement (eg diffraction grating, lasers, variable resistance signal conditioning).

Transmitters/signal converters: current to pressure; pressure to current; microprocessor based ('smart'); digital; analogue.

Transmission medium: pneumatic; hydraulic; electrical; fibre-optic

Signal conditioners: operational amplifiers; voltage to voltage; voltage to current; current to voltage; charge amplifier.

Process control systems and controllers

Need for process control: quality; safety; consistency of product; optimum plant performance; human limitations; efficiency; cost; environmental

Process controller terminology: deviation; range; span; absolute deviation; control effect; set point; process variable; manipulated variable; measured variable; bumpless transfer; process variable tracking; direct and reverse acting; offset; proportional band; gain; on-off control; two step control; cycling; proportional; proportional with integral; proportional with integral and derivative; proportional with derivative

System terminology: distance velocity lags; transfer lags; multiple transfer lags; capacity; resistance; dead time; reaction rate; inherent regulation; dead time; open loop; closed loop; load; supply; static gain; dynamic gain; stability; loop gain

Tuning techniques: Zeigler-Nichols; continuous cycling; reaction curve; $\frac{1}{4}$ decay methods; tuning for no overshoot on start-up; tuning for some overshoot on start-up

System representation: P and I diagrams; loop diagrams; wiring diagrams; constructing and using diagrams to appropriate standards

Regulating units

Regulating unit terminology: body; trim; plug guide and seat; valve; stem; bonnet; packing gland; yoke; actuator; motor; stroke; direct and reverse action; air fail action; repeatability; CV; turndown; flow characteristics; linear, equal percentage, quick-opening, modified parabolic, split range

Regulating units: dampers; power cylinders; louvres; valve positioners; valves (globe, ball, diaphragm, gate, double seated, 3-way, solenoid, split bodied, butterfly)

Second law of thermodynamics: statement of law; schematic representation of a heat engine to show heat and work flow



Heat engine cycles: Carnot cycle; Otto cycle; Diesel cycle; Dual combustion cycle; Joule cycle; property diagrams; Carnot efficiency; air-standard efficiency

Performance characteristics: engine trials; mean effective pressure; indicated and brake power; indicated and brake thermal efficiency; mechanical efficiency; specific fuel consumption; heat balance

Improvements: turbo-charging; turbo-charging and inter-cooling; cooling system and exhaust gas heat recovery systems.

Air compressors

Property diagrams: theoretical pressure-volume diagrams for single and multi-stage compressors; actual indicator diagrams; actual isothermal and adiabatic compression curves; induction and delivery line; effects of clearance volume

Performance characteristics: free air delivery; volumetric efficiency; actual and isothermal work done per cycle; isothermal efficiency

First law of thermodynamics: input power; air power; heat transfer to intercooler and after cooler; energy balance

Faults and hazards: effects of water in compressed air; causes of compressor fires and explosions

Steam and gas turbine

Principles of operations: impulse and reaction turbines; condensing; pass-out and back pressure turbines; single and double shaft gas turbines; regeneration and re-heat in gas turbines; combined heat and power plants

Circuit and property diagrams: circuit diagrams to show boiler/heat exchanger; superheater; turbine; condenser cooling water circuit; hot well; economiser/feedwater heater; condenser extraction and boiler feed pumps; temperature-entropy diagram of Rankine cycle.

Performance characteristics: Carnot and Rankine cycle efficiencies; turbine isentropic efficiency; power output; use of property tables and enthalpy-entropy diagram for steam.

Refrigerators and heat pumps

Reversed heat engines: reversed Carnot and Rankine cycles; vapour compression cycle; second law of thermodynamics; temperature-entropy diagrams; pressure-enthalpy diagrams; refrigeration tables and charts; refrigerant fluids; environmental effects

Refrigerators: refrigeration effect; coefficient of performance

Heat pumps: heating effect; coefficient of performance; economics of heat pumps

Design and applications

Efficiency of marine diesels: power to weight ratios; efficiencies of two and four stroke engines and their running costs, turbo-charging, waste heat recovery.



Mechanical and thermal stresses: selection and use of materials, relative sizes and dimensions, stress reversal and fatigue failure, thermal stressing (eg environmental and generated thermal conditions; exposure to both high and low temperatures)

Designs to limit atmospheric pollution: cross-head engine design and trunk piston design, fuel oil injection methods, exhaust gas re-circulation, homogenisation, direct water injection, water mist, exhaust gas scrubbers, and catalytic reduction.

Constructional methods

Transmission of propulsion forces: bedplates, thrust bearings, holding down arrangements.

Crankshafts: manufacturing methods (eg forged and fabricated crankshafts), methods for crankshaft alignment and deflections, causes and effects of misalignment

Transmission of combustion forces: construction of the engine, framing and tie bolts, running gear, cylinder liners and heads.

Engine timing and combustion: camshaft drives and cams, reversing, fuel pumps, injectors and valves, air start systems.

Operational Parameters

Operational data: power and draw cards, peak and compression pressures, log book trends
Monitoring: types of lubricating oil used in diesel engines, ??in full?? (LO) testing, bearing temperature measurement, oil mist measurement, protection devices in case of abnormal operation (eg crankcase explosions, scavenge fires), engine monitoring, slow downs and Shut downs

Atmospheric Pollutants: Nox, Sox, CO₂, impact of Marpol 73/78 and US Federal and State Regulations on the design and operation of diesel engines

Operating procedures: requirements and use of SOLAS 74 Construction regulations and Classification Society regulations for marine diesel engines

Maintenance of marine diesel engines

Types and need for maintenance: planned maintenance (eg based on running hours, application of maintenance schedules, use of manufacturer's guidance and manuals), expected and projected life of components, repair and breakdown maintenance

Maintenance plans: permit to work, risk analysis, availability of human and physical resources, downtime, (COSWP)

Planned maintenance: continuous survey by classification societies, approved planned maintenance systems, coordinating maintenance with dry docking schedules and off hire periods.

Marine boilers

Design features: layout of generating tubes, drums and headers; drum internals; type and layout of super heaters, economisers, air heaters; boiler mountings; combustion equipment; soot blowers; boiler control systems and safety devices; feed water systems; mountings and fittings that allow the safe operation of marine boilers, methods used to increase the operating efficiency.



Construction of marine boilers: use and purpose of materials; methods of securing tubes; use of refractory materials; allowance for expansion.

Marine turbines

Design and operating principles: steam turbines - impulse and reaction types, compounding, rotors and blading, casings, nozzles and nozzle blocks, gland sealing, condensers, control systems, safety devices; gas turbines - single and double shaft, re-generation and re-heat, centrifugal and axial compressors **Construction:** use and purpose of materials; rotors and blading assembly; gland sealing arrangements; bearings; casing supports; condenser assembly.

Marine power transmission systems

Design features: types of gearing (eg compound reduction gears, epicyclic gearing), gear tooth nomenclature, gear tooth faults; transmission bearings and shafts; lubricating oil specification, theory of lubrication

Construction and setting-up: use and purpose of materials; gearing alignment; shaft alignment; thrust block and bearing mounting

Operational and maintenance parameters

Operational availability: start up and shut down procedures; monitoring of plant for correct running and operating anomalies.

Operating anomalies: e.g. incorrect combustion, economiser and air heater fires, turbine failure, feed system component failure, feed water contamination

Maintenance: routine and preventative maintenance, boiler water testing and treatment; testing and treatment of lubricating oil; major overhauls; surveys and statutory requirements.

Signals and noise

Logarithmic units: decibels, related to power, current and voltage ratios **Reference levels:** dBA; dBW; dBm

Types and sources of noise: thermal; radiated; distortion (eg clipping or cross-over); mains borne; sparking; cross-talk and consider noise reduction techniques (eg screening).

Concepts: signal-noise ratio; noise factor; noise temperature

Types of amplifier

Analyse: using quantitative methods; equivalent circuits; computer modelling

Types of amplifier: power; tuned; operational

Performance: frequency response; gain/bandwidth product; distortion; input and output impedance.

Modify circuit designs: using manufacturers' data; circuit calculations



Revised specifications: using alternative components to achieve lower cost or to improve performance

Circuits with feedback

Types of feedback: voltage; current; series; shunt.

Circuit performance: effect of feedback on gain, bandwidth, distortion, noise, gain stability, input and output impedance.

Circuit: single-stage transistor amplifier; operational amplifier.

Investigate: practical measurement; computer simulation.

Oscillators

Circuit conditions: $1 - \beta A = 0$ at only one frequency; gain-phase relationship in the circuit

Build and evaluate: using given formulae build a typical circuit configuration such as Wien Bridge, phase shift, LC coupled, transistor or operational amplifier

Specification: factors such as frequency, stability, frequency drift, distortion

Crystal Oscillator advantages: frequency accuracy and stability

Electrical power distribution and protection equipment

Plant in use: main electrical supplies (eg distribution systems, insulated and earthed neutral systems, preferential trips, shore supply connection, emergency switchboard connection); transformers (eg as metering device, isolation device, protection requirements).

Safety protection devices in distribution systems: high rupturing capacity (HRC) fuses; isolators; circuit breakers (eg over-current, over-voltage, under-voltage, reverse power).

Emergency back-up systems: emergency power supplies (eg batteries, uninterruptible power supplies (UPS) systems, emergency generator, emergency switchboard)

Electrical equipment in hazardous areas

Explosion proof (Ex) equipment and apparatus: Ex certified equipment and labelling; hazardous areas (eg combustible materials, ignition of gas/air mixtures, hazardous cargo); markings of all apparatus groups and temperature classifications

Maintenance: maintenance of equipment in a real or simulated hazardous environment (e.g. luminaire, junction box).

Low and high voltage environments

Safety procedures: electrical safety and electric shock levels; low voltage (LV) and high voltage (HV) environments (eg generation, switchboards, distribution boards, propulsion); isolation and permit-to-work procedures.



Maintenance: routine maintenance on electrical equipment; maintenance procedures; use of manufacturers' manuals/guidelines; maintenance records

Fault location: recognition of electrical fault types (eg open-circuit, short-circuit, earth faults); faultfinding procedures; use of test equipment (eg multimeter, voltmeter, megger, clamp meter); location of fault and rectification method

High voltage systems: eg electric propulsion, bow-thrusters, cargo pumps, air conditioning, passenger ship distribution.

Marine pumps and pumping systems

System heads: pump suction and discharge conditions (eg suction and discharge heads, head losses, vapour pressure, net positive suction head, total head).

Types: roto-dynamic pumps (eg centrifugal pumps, both single and double entry, diffuser pumps, axial flow pumps, liquid ring air pumps, regenerative pumps, multi-stage pumps, deepwell cargo pumps); rotary and reciprocating positive displacement pumps (eg gear pumps, screw pumps, progressive cavity pumps, diaphragm pumps, rotary piston pumps, vane pumps, simplex and duplex pumps).

Applications: e.g. bilge, ballast and seawater systems, tanker cargo systems, water pollution prevention such as, oil-water separators, ballast exchange systems; ram and rotary steering gear systems, tubular and plate type heat exchangers, priming and air handling methods, sealing arrangements, hydraulic balancing, air vessels

Performance characteristics: typical performance curves for roto-dynamic and positive displacement pumps (eg head, flow, power, efficiency, Net Positive Suction Head available, Net Positive Suction Head required, best efficiency point, shut-off head, pumping in parallel and series, effects of operation under off-design conditions)

Operational difficulties: cause and identification of difficulty (eg corrosion, erosion, cavitation and vibration, impeller suction and discharge recirculation problems); routine and preventative maintenance procedures for pumps and pumping systems (eg renewal of gland sealing arrangements, checking of internal clearances, manufacturers' manuals/procedures).

Shipboard hotel services equipment

Types and operation: refrigeration (eg operating cycles, storage temperatures, properties of refrigerants, system components, rotary and reciprocating compressors); air-conditioning (e.g. principles, comfort zone, types of air conditioning systems: zone control, double duct, and reheat systems); bacterial control methods (eg prevention of Legionella bacterium and mould related illnesses); desalination equipment and potable water systems (eg submerged tube and plate evaporators, flash evaporators, vapour compression plant, reverse osmosis plant); potable water sterilisation and conditioning; sewage handling systems (eg holding tanks, vacuum systems, biological treatment, zero discharge systems).

Malfunctions: identification and rectification of typical plant operational problems (eg due to component wear, mechanical breakdown and operator error)



Maintenance procedures: appropriate routine and preventative maintenance procedures on hotel services equipment and components (eg refrigeration - leak detection, addition and removal of refrigerant, servicing driers, compressor valve overhaul, lubrication; air conditioning - monitoring air quality, maintaining plant cleanliness; desalination - scale control, using maintenance chemicals, maintaining reverse osmosis filters; domestic water sterilisation - techniques for confirming effectiveness; sewage systems - safe working practices, maintaining effluent quality standards).

Fire safety

Fire protection systems: fire extinguishing and extinguishing media; portable extinguishers and fixed installations (eg multi-cylinder and bulk CO₂, foam, automatic sprinkler, water mist and fire main systems); tanker inert gas plant; fire detection equipment (eg thermal, ionisation, flame and smoke detectors)

Regulatory requirements: fire control plans; fire drills; international shore connection; regulatory measures (eg International Convention for the Safety of Life at Sea regulations, classification society and statutory surveys)

Causes of fire: ignition of flammable liquid leaks and overflows; hot work; machinery fires and explosions; cargo fires.

Maintenance procedures

Establish resources: human and physical resource planning techniques (eg time and resource scheduling techniques, Gant charts, critical path analysis, computer software-based solutions).

Prepare documentation: record sheets; technical reports; risk assessments; permit-to-work forms.

Safe working practice: Code of Safe Working Practice; isolation and permit-to-work procedures.

Routine and preventative maintenance: need for routine maintenance; planned maintenance procedures; recognition of faults; faultfinding procedures.

Law, codes and other forms of guidance, The requirements of records for commercial and legislative purposes:

International Conventions and Treaties, legislation, Codes of Practice and M Notices, an overview of UK Civil and Criminal Law, an overview of Flag and Port State Control, recording methods available; written records, automatic data recorders, requirement for accuracy in record keeping, confidential nature of records and the access that can be afforded them: commercial, legal, personal

Personal and corporate penalties, for unlawful Acts or Omissions and for breaches of company regulations, The law, codes, principles and procedures and other forms of guidance of:

LSA, FFA, , ISM or relevant Codes, The fundamental principles of anti-pollution legislation, MARPOL Convention, Annexes and related legislation, Company procedures for compliance with MARPOL, Penalties for non-compliance.



Agreements and conventions

Agreements and convention: Certification, Loadlines, SOLAS, MARPOL, Health Regulations, Safety of Ship, passengers, crew and cargo, National legislation for implementing International agreements, Conditions for issuing, validity, extension and content of statutory certificates and documents.

The principles and application of UK and international legislation including the principles of UK and international legislation including:

The laws of contract, tort and agency: Liens, Arbitration, UNCLOS III, Statutory and other records including the OLB and OR, Legal responsibility of the master with respect to: Distres, Collision, Encountering navigational hazards, Pollution, Salvage, Towage, Pilotage, The application of UK and international legislation including Flag State Surveys, Classification and other surveys, Port State Control surveys Record keeping and the collection of evidence.

Objectives of individuals

Job descriptions: analysis of jobs, behaviour, responsibilities and tasks; pay, bonus and incentives.

Responsibilities: direct and indirect relationships

Performance targets: personal; financial; quantity and quality; incorporation within a job description; setting and monitoring performance targets

Performance of individuals

Individual appraisal systems: reasons for using performance appraisals (eg to determine salary levels and bonus payments, promotion strengths and weaknesses, training needs, communication); establishing appraisal criteria (eg production data, personnel data, judgemental data); rating methods (eg ranking, paired comparison, checklist, management by objectives) **Staff appraisal:** conduct of performance reviews (eg by supervisor, peers, committee, subordinates or self-appraisal); feedback of results and resolution of conflicts; encouragement as a motivator for the achievement of performance targets.

Roles and responsibilities of teams

Teams: management teams and peer groups (eg focus groups, task groups, project groups and panels); purpose of teams (eg long and short-term, specific project or task, view-seeking both within the company and from external sources, communication)

Team responsibilities: to superiors, subordinates, the business, each other and external groups (eg meeting performance targets; communicating results; confidentiality; deadlines).

Internal team management: hierarchical; functional

Performance of teams

Team appraisal systems: reasons for appraising team performance (eg team effectiveness, contribution to business, constitution of team, identifying individuals' contribution to team effort and determining the need to establish other team criteria); performance measurement criteria (eg outcome data, achieved improvements, employee morale, value added).



Team appraisal: conducting team performance reviews (eg by an individual manager, a group of managers, an outside person or team self-appraisal); feedback of results and resolution of conflicts within the team; encouragement of overall team performance as a motivator for the achievement of business objectives

Safe working procedures

Permit-to-work: types; HSE Guidance Notes; hot cold entry; buddy and plant identification systems.

Isolations: eg lock, multi-lock, blank off, removal, electrical, peg removal, linked valve key, SDNT valves.

Monitoring equipment: e.g. noise, dust, fumes, temperature, movement, radiation, costing.

Protective clothing and equipment: e.g. chemical, temperatures, crush resistance, noise protection, visor, goggle usage, electrical isolation, radioactive protection

Current health and safety legislation

Current regulations: relevant and current UK and EU regulations (eg COSHH, noise at work, pressure systems, manual handling, personal protective equipment, control of asbestos, Health and Safety at Work Act, management of health and safety at work, IEE wiring regulations, EMC directive) on typical engineering operations (eg engineering production and manufacture, engineering services, materials handling, telecommunications and transportation).

HSE Inspectorate: role; span of authority; right of inspection; guidance notes and booklets.

Safety audits: policies; record keeping; safety surveys; training; proformas; management commitment; planning.

Codes of practice: use of Applying Technology for codes and regulations; awareness of relevant codes of practice (eg HSE guidance, Occupational Exposure Standards, etc.).

Assessment of risk

Hazard: e.g. fire, noise, temperature, field of vision, fumes, moving parts, lighting, access, pressure, falling bodies, airborne debris, radiation and chemical hazards, etc. **Risk rating:** matrix production (eg low risk, moderate risk, substantial risk, high risk). **Frequency:** rate of occurrence (eg improbable, possible, occasional, frequent, regular, common).

Severity: definitions of consequence; level of injury (eg graded: trivial, minor, major, multiple major, death, multiple death)

Record: systems; production of proforma for each hazard; types of recording systems; employee training; company awareness

Risk management

Evidence: to support the likelihood of or reoccurrence of a risk; statistical data (eg fatigue charts, working hours, temperature, lighting levels, noise, incorrect procedures, working practices, time of day, etc.).



Implications: e.g. threat to life, injuries, property, environment, need to redesign, effect on company, effect on other companies; mandatory factory closure

Information: e.g. data sheets on substances, factory rules, codes of practice; safe working procedures, hazard identification (eg hard hat area); training in procedures for new staff and contractors

Minimising risk: e.g. control of known risks, guarding, covering, screening, encasing, designout; disaster contingency planning, etc.

Implementation: e.g. management policy, lines of communication, responsibility, safety committees and trade union input.

Compliance: knowledge of regulations and guidelines; mandatory compliance with current and relevant regulations (eg HASAWA and HSE; Deposit of Poisonous waste Act, EMC directive, etc.), working towards company risk assessment findings

Emergency and damage control plans

Prepare plans for response to emergencies, including: Responding to distress and medical emergencies, Main engine failure, Steering gear failure, Man overboard Fire, Dragging anchor, Imminent collision and collision, Stranding and grounding Flooding, Passenger and cargo emergencies, Stability emergencies, Enclosed space rescues, Pollution, Parting of lines and tow ropes, Piracy, terrorist activity, armed robbery and other security issues, Port of refuge, Abandon ship, Precautions for the protection and safety of persons on board, Initial actions and response, Communications and signals required, Procedures to be followed, Pollution and damage control.

Implementing emergency and damage control procedures

The value of drills and other training to cope with emergencies: *The drills, and their organisation, required to comply with current national and international, legislation in respect of the situations listed above, The action to take as Chief Engineer/Second Engineer in the event of emergencies at sea or in port, as applicable, including the situations shown above, Emergency towing arrangements and procedures Procedures for refloating a vessel with and without assistance.*

Search and rescue operations

The obligations and responsibilities for assistance at sea and the action to be taken to render assistance: IAMSAR Manual, Annual Summary of Admiralty Notices to Mariners - Notice 4, Consultation with other stations answering the distress Legal obligations, Exemptions from answering a distress, Logbook entries.

Plan and prepare a search

Categories of distress incidents: Coastal and ocean, Abbreviations, terms and definitions, Communications: internal and external, Co-ordination of search and rescue operations, Designation of SMC and OSC and their responsibilities

Responsibility of other craft in the co-ordinated search, Search patterns taking into account drift, leeway, visibility and type of assistance available, Drift patterns of disabled vessels with relation to



wind and currents, Rendezvous, Establish a datum point before commencing search pattern,
Contingency planning and training

Conduct a Search And Sescue (SAR) operation

Proceeding to the area of distress, On board preparation, Action by assisting ships
Approaching the scene, radar search, Arrival on scene, implement search plan
Assistance by SAR aircraft, Homing on radio signals, Aircraft casualties

Conduct a rescue

When survivors in the water/boats/rafts, From ditched aircraft, Fire, Heavy weather, Evacuation by
helicopter

Terminate SAR operations

Care for and questioning of survivors, Decision to terminate, factors to consider, Reports to
authorities

4. International Safety Management (ISM) Code 2002

Preamble

The ISM Code is a set of rules set by the International Maritime Organisation (IMO) Assembly which is the legislative body for the shipping industry. The following describes the purpose of, and the reasons, for the Code.

1 The purpose of this Code is to provide an international standard for the safe management and operation of ships and for pollution prevention.

2 The Assembly adopted resolution A.443 (XI), by which it invited all Governments to take the necessary steps to safeguard the shipmaster in the proper discharge of his responsibilities with regard to maritime safety and the protection of the marine environment.

3 The Assembly also adopted resolution A.680(17), by which it further recognized the need for appropriate organization of management to enable it to respond to the need of those on board ships to achieve and maintain high standards of safety and environmental protection.

4 Recognizing that no two shipping companies or ship-owners are the same, and that ships operate under a wide range of different conditions, the Code is based on general principles and objectives.

5 The Code is expressed in broad terms so that it can have a widespread application. Clearly, different levels of management, whether shore-based or at sea, will require varying levels of knowledge and awareness of the items outlined.

6 The cornerstone of good safety management is commitment from the top. In matters of safety and pollution prevention it is the commitment, competence, attitudes and motivation of individuals at all levels that determines the end result.

1.1 Part A - Implementation



1 General

1.1 Definitions

The following definitions apply to parts A and B of this Code.

1.1.1 "International Safety Management (ISM) Code" means the International Management Code for the Safe Operation of Ships and for Pollution Prevention as adopted by the Assembly, as may be amended by the Organization.

1.1.2 "Company" means the owner of the ship or any other organization or person such as the manager, or the bareboat charterer, who has assumed the responsibility for operation of the ship from the ship owner and who, on assuming such responsibility, has agreed to take over all duties and responsibility imposed by the Code.

1.1.3 "Administration" means the Government of the State whose flag the ship is entitled to fly.

1.1.4 "Safety management system" means a structured and documented system enabling Company personnel to implement effectively the Company safety and environmental protection policy.

1.1.5 "Document of Compliance" means a document issued to a Company which complies with the requirements of this Code.

1.1.6 "Safety Management Certificate" means a document issued to a ship which signifies that the Company and its shipboard management operate in accordance with the approved safety management system.

1.1.7 "Objective evidence" means quantitative or qualitative information, records or statements of fact pertaining to safety or to the existence and implementation of a safety management system element, which is based on observation, measurement or test and which can be verified.

1.1.8 "Observation" means a statement of fact made during a safety management audit and substantiated by objective evidence.

1.1.9 "Non-conformity" means an observed situation where objective evidence indicates the non-fulfilment of a specified requirement.

1.1.10 "Major non-conformity" means an identifiable deviation that poses a serious threat to the safety of personnel or the ship or a serious risk to the environment that requires immediate corrective action and includes the lack of effective and systematic implementation of a requirement of this Code.

1.1.11 "Anniversary date" means the day and month of each year that corresponds to the date of expiry of the relevant document or certificate.

1.1.12 "Convention" means the International Convention for the Safety of Life at Sea, 1974, as amended.

1.2 Objectives



1.2.1 The objectives of the Code are to ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment, in particular to the marine environment and to property.

1.2.2 Safety management objectives of the Company should, inter alia:

- 1 provide for safe practices in ship operation and a safe working environment;
- 2 establish safeguards against all identified risks; and
- 3 continuously improve safety management skills of personnel ashore and aboard ships, including preparing for emergencies related both to safety and environmental protection.

1.2.3 The safety management system should ensure:

- 1 compliance with mandatory rules and regulations; and
- 2 that applicable codes, guidelines and standards recommended by the Organization, Administrations, classification societies and maritime industry organizations are taken into account.

1.3 Application

The requirements of this Code may be applied to all ships.

1.4 Functional requirements for a safety management system

Every Company should develop, implement and maintain a safety management system which includes the following functional requirements:

- 1 a safety and environmental-protection policy;
- 2 instructions and procedures to ensure safe operation of ships and protection of the environment in compliance with relevant international and flag State legislation;
- 3 defined levels of authority and lines of communication between, and amongst, shore and shipboard personnel;
- 4 procedures for reporting accidents and non-conformities with the provisions of this Code;
- 5 procedures to prepare for and respond to emergency situations; and
- 6 procedures for internal audits and management reviews.

2 Safety and Environmental-Protection Policy

2.1 The Company should establish a safety and environmental-protection policy which describes how the objectives given in paragraph 1.2 will be achieved.



2.2 The Company should ensure that the policy is implemented and maintained at all levels of the organization, both ship-based and shore-based.

3 Company Responsibilities and Authority

3.1 If the entity/person who is responsible for the operation of the ship is other than the owner, the owner must report the full name and details of such entity should be given to the Administration.

3.2 The Company should define and document the responsibility, authority and interrelation of all personnel who manage, perform and verify work relating to and affecting safety and pollution prevention.

3.3 The Company is responsible for ensuring that adequate resources and shore-based support are provided to enable the designated person or persons to carry out their functions.

4 Designated Person(s)

To ensure the safe operation of each ship and to provide a link between the Company and those on board, every Company, as appropriate, should designate a person or persons ashore having direct access to the highest level of management. The responsibility and authority of the designated person or persons should include monitoring the safety and pollution-prevention aspects of the operation of each ship and ensuring that adequate resources and shore-based support are applied, as required.

5 Master's Responsibility and Authority

5.1 The Company should clearly define and document the master's responsibility with regard to:

- 1 implementing the safety and environmental-protection policy of the Company;
- 2 motivating the crew in the observation of that policy;
- 3 issuing appropriate orders and instructions in a clear and simple manner;
- 4 verifying that specified requirements are observed; and
- 5 reviewing the safety management system and reporting its deficiencies to the shore-based management.

5.2 The Company should ensure that the safety management system operating on board the ship contains a clear statement emphasizing the master's authority. The Company should establish in the safety management system that the master has the overriding authority and the responsibility to make decisions with respect to safety and pollution prevention and to request the Company's assistance as may be necessary.

6 Resources and Personnel

6.1 The Company should ensure that the master is:



- 1 properly qualified for command;
- 2 fully conversant with the Company's safety management system; and
- 3 given the necessary support so that the master's duties can be safely performed.

6.2 The Company should ensure that each ship is manned with qualified, certificated and medically fit seafarers in accordance with national and international requirements.

6.3 The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarization with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given.

6.4 The Company should ensure that all personnel involved in the Company's safety management system have an adequate understanding of relevant rules, regulations, codes and guidelines.

6.5 The Company should establish and maintain procedures for identifying any training which may be required in support of the safety management system and ensure that such training is provided for all personnel concerned.

6.6 The Company should establish procedures by which the ship's personnel receive relevant information on the safety management system in a working language or languages understood by them.

6.7 The Company should ensure that the ship's personnel are able to communicate effectively in the execution of their duties related to the safety management system.

7 Developments of Plans for Shipboard Operations

The Company should establish procedures for the preparation of plans and instructions, including a family business knowledge framework as appropriate, for key shipboard operations concerning the safety of the ship and the prevention of pollution. The various tasks involved should be defined and assigned to qualified personnel.

8 Emergency Preparedness

8.1 The Company should establish procedures to identify, describe and respond to potential emergency shipboard situations.

8.2 The Company should establish programmes for drills and exercises to prepare for emergency actions.

8.3 The safety management system should provide for measures ensuring that the Company's organization can respond at any time to hazards, accidents and emergency situations involving its ships.

9 Reports and Analysis of Non-Conformities, Accidents and Hazardous Occurrences



9.1 The safety management system should include procedures ensuring that non-conformities, accidents and hazardous situations are reported to the Company, investigated and analysed with the objective of improving safety and pollution prevention.

9.2 The Company should establish procedures for the implementation of corrective action.

10 Maintenance of the Ship and Equipment

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

10.2 In meeting these requirements the Company should ensure that:

- 1 inspections are held at appropriate intervals;
- 2 any non-conformity is reported, with its possible cause, if known;
- 3 appropriate corrective action is taken; and
- 4 records of these activities are maintained.

10.3 The Company should establish procedures in its safety management system to identify equipment and technical systems the sudden operational failure of which may result in hazardous situations. The safety management system should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of stand-by arrangements and equipment or technical systems that are not in continuous use.

10.4 The inspections mentioned in 10.2 as well as the measures referred to in 10.3 should be integrated into the ship's operational maintenance routine.

11 Documentation

11.1 The Company should establish and maintain procedures to control all documents and data which are relevant to the safety management system.

11.2 The Company should ensure that:

- 1 valid documents are available at all relevant locations;
- 2 changes to documents are reviewed and approved by authorized personnel; and
- 3 obsolete documents are promptly removed.

11.3 The documents used to describe and implement the safety management system may be referred to as the Safety Management Manual. Documentation should be kept in a form that the Company considers most effective. Each ship should carry on board all documentation relevant to that ship.



12 Company Verification, Review and Evaluation

12.1 The Company should carry out internal safety audits to verify whether safety and pollution-prevention activities comply with the safety management system.

12.2 The Company should periodically evaluate the efficiency of and, when needed, review the safety management system in accordance with procedures established by the Company.

12.3 The audits and possible corrective actions should be carried out in accordance with documented procedures.

12.4 Personnel carrying out audits should be independent of the areas being audited unless this is impracticable due to the size and the nature of the Company.

12.5 The results of the audits and reviews should be brought to the attention of all personnel having responsibility in the area involved.

12.6 The management personnel responsible for the area involved should take timely corrective action on deficiencies found.

4.2 PART B - CERTIFICATION AND VERIFICATION

13 Certification And Periodical Verification

13.1 The ship should be operated by a Company which has been issued with a Document of Compliance or with an Interim Document of Compliance in accordance with paragraph 14.1, relevant to that ship.

13.2 The Document of Compliance should be issued by the Administration, by an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government to the Convention to any Company complying with the requirements of this Code for a period specified by the Administration which should not exceed five years. Such a document should be accepted as evidence that the Company is capable of complying with the requirements of this Code.

13.3 The Document of Compliance is only valid for the ship types explicitly indicated in the document. Such indication should be based on the types of ships on which the initial verification was based. Other ship types should only be added after verification of the Company's capability to comply with the requirements of this Code applicable to such ship types. In this context, ship types are those referred to in regulation IX/1 of the Convention.

13.4 The validity of a Document of Compliance should be subject to annual verification by the Administration or by an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government within three months before or after the anniversary date.



13.5 The Document of Compliance should be withdrawn by the Administration or, at its request, by the Contracting Government which issued the Document when the annual verification required in paragraph 13.4 is not requested or if there is evidence of major non-conformities with this Code.

13.5.1 All associated Safety Management Certificates and/or Interim Safety Management Certificates should also be withdrawn if the Document of Compliance is withdrawn.

13.6 A copy of the Document of Compliance should be placed on board in order that the master of the ship, if so requested, may produce it for verification by the Administration or by an organization recognized by the Administration or for the purposes of the control referred to in regulation IX/6.2 of the Convention. The copy of the Document is not required to be authenticated or certified.

13.7 The Safety Management Certificate should be issued to a ship for a period which should not exceed five years by the Administration or an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government. The Safety Management Certificate should be issued after verifying that the Company and its shipboard management operate in accordance with the approved safety management system. Such a Certificate should be accepted as evidence that the ship is complying with the requirements of this Code.

13.8 The validity of the Safety Management Certificate should be subject to at least one intermediate verification by the Administration or an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government. If only one intermediate verification is to be carried out and the period of validity of the Safety Management Certificate is five years, it should take place between the second and third anniversary dates of the Safety Management Certificate.

13.9 In addition to the requirements of paragraph 13.5.1, the Safety Management Certificate should be withdrawn by the Administration or, at the request of the Administration, by the Contracting Government which has issued it when the intermediate verification required in paragraph 13.8 is not requested or if there is evidence of major non-conformity with this Code.

13.10 ,Notwithstanding the requirements of paragraphs 13.2 and 13.7, when the renewal verification is completed within three months before the expiry date of the existing Document of Compliance or Safety Management Certificate, the new Document of Compliance or the new Safety Management Certificate should be valid from the date of completion of the renewal verification for a period not exceeding five years from the date of expiry of the existing Document of Compliance or Safety Management Certificate.

13.11 ,When the renewal verification is completed more than three months before the expiry date of the existing Document of Compliance or Safety Management Certificate, the new Document of Compliance or the new Safety Management Certificate should be valid from the date of completion of the renewal verification for a period not exceeding five years from the date of completion of the renewal verification."

14 Interim Certification

14.1 An Interim Document of Compliance may be issued to facilitate initial implementation of this Code when:



- 1 a Company is newly established; or
- 2 new ship types are to be added to an existing Document of Compliance,

following verification that the Company has a safety management system that meets the objectives of paragraph 1.2.3 of this Code, provided the Company demonstrates plans to implement a safety management system meeting the full requirements of this Code within the period of validity of the Interim Document of Compliance. Such an Interim Document of Compliance should be issued for a period not exceeding 12 months by the Administration or by an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government. A copy of the Interim Document of Compliance should be placed on board in order that the master of the ship, if so requested, may produce it for verification by the Administration or by an organization recognized by the Administration or for the purposes of the control referred to in regulation IX/6.2 of the Convention. The copy of the Document is not required to be authenticated or certified.

14.2 An Interim Safety Management Certificate may be issued:

- 1 to new ships on delivery;
- 2 when a Company takes on responsibility for the operation of a ship which is new to the Company; or
- 3 when a ship changes flag.

Such an Interim Safety Management Certificate should be issued for a period not exceeding 6 months by the Administration or an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government.

14.3 An Administration or, at the request of the Administration, another Contracting Government may, in special cases, extend the validity of an Interim Safety Management Certificate for a further period which should not exceed 6 months from the date of expiry.

14.4 An Interim Safety Management Certificate may be issued following verification that:

- 1 the Document of Compliance, or the Interim Document of Compliance, is relevant to the ship concerned;
- 2 the safety management system provided by the Company for the ship concerned includes key elements of this Code and has been assessed during the audit for issuance of the Document of Compliance or demonstrated for issuance of the Interim Document of Compliance;
- 3 the Company has planned the audit of the ship within three months;
- 4 the master and officers are familiar with the safety management system and the planned arrangements for its implementation;
- 5 instructions, which have been identified as being essential, are provided prior to sailing; and



- 6 relevant information on the safety management system has been given in a working language or languages understood by the ship's personnel.

15 Verification

15.1 All verifications required by the provisions of this Code should be carried out in accordance with procedures acceptable to the Administration, taking into account the guidelines developed by the Organization.

16 Forms of Certificates

16.1 The Document of Compliance, the Safety Management Certificate, the Interim Document of Compliance and the Interim Safety Management Certificate should be drawn up in a form corresponding to the models given in the Code. If the language used is neither English nor French, the text should include a translation into one of these languages.

16.2 In addition to the requirements of paragraph 13.3, the ship types indicated on the Document of Compliance and the Interim Document of Compliance may be endorsed to reflect any limitations in the operations of the ships described in the safety management system.

Although ISM code brings all the industry to a minimum standard for safety, leading shipping companies adopt further quality management standard as well as environmental standards.