Transport Canada Transports Canada

TP 10935E
(12-2011)

Engine Room Simulator–base Courses

2nd EDITION
December 2011

TC-1004695

Canada

Responsible Authority	Approval
The Director, Marine Personnel Standards and Pilotage is responsible for this document, including any change, correction, or update.	**"original signed by Naim Nazha"** Capt. Naim Nazha Director, Marine Personnel Standards and Pilotage Marine Safety

Original Date Issued: **April 1992** Date Revised: **December 2011**

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DOCUMENT INFORMATION

Title	**Engine Room Simulator–Base Courses**		
TP No.	**10935E**	**Edition**	**2** **RDIMS # 6168700 v.13**
Catalogue No.	**978-1-100-20575-5**	**ISBN**	**T29-103/2012E-PDF**
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REVISIONS

Last Review

Next Review

Revision No.	Date of Issue	Affected Pages	Author(s)	Brief Description of Change
1	1 September, 2008	All	B. Duguay	Complete review of TP in accordance with CSA 2001
2	17 October 2008	26 et seq.	E.G. Millar	Addition of Syllabus
3	2 June 2010	26 et seq	E.G. Millar	Inclusion of IMO Model Course, 2.07
4	04 March 2011	9, 28, 29, 30, 31, 41, 42, 45, 46 and 47	Toni Becherrawi	Inclusion of IMO Model Course, 2.07
5	December 2011	All	Toni Becherrawi	Complete review of TP in accordance with CSA 2001 and STCW Manila Convention

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1. SCOPE AND APPLICATION

1.1. PURPOSE

1. The International Convention on Standards of Training, Certification and Watchkeeping for seafarers, as amended (STCW Convention), provides standards regarding the use of simulator in Chapter I of the mandatory Code "A".
2. Canada has made training on engine room simulator-base courses mandatory to obtain certain level of engineering officer's certificates of competency.
3. This publication is intended to provide guidance to Recognized Institutions that wish to be approved under the *Marine Personnel Regulations* to provide a training certificate at the appropriate level of engine room simulator-base course.
4. This publication is intended to provide information to marine stakeholders with respect to programme content and the general conditions associated with engine room simulator-base courses, conducted at Recognized Institutions.

1.2. SCOPE

This publication is intended to provide guidelines and standards to conduct engine room simulator–base courses, instructional techniques involving the use of engine room simulators, and operational experience on the particular type of engine room being used for the training of marine engineers.

1.3. AUTHORITY

1. Section 16 of the *Canada Shipping Act, 2001* provides for the Minister of Transport to specify the manner in which Canadian maritime documents are issued
2. Section 114 of the *Marine Personnel Regulations* (MPR)
3. The Examination and Certification of Seafarers TP-2293.

1.4. DOCUMENTS REPLACED

Original version of TP 10935

2. GENERAL

2.1. OBJECTIVES

The performance standards and other provisions set forth in this document are necessary to:

a) meet the requirements related to a training certificate for Ship watchkeeping practices using a propulsive plant simulator, Ship management practices taught using a propulsive plant simulator and Domestic Ship watchkeeping practices using a propulsive plant simulator prescribed in the MPR.
b) determine the level of qualifications for instructors, supervisors and assessors that are with engine room simulator-base courses.
c) establish the engine room simulator-base courses objectives and procedures
d) provide standards and procedures for assessment of competency.
e) set the basic equipments required for engine room simulator–base courses.
f) establish the general performance standards for an engine room simulator.

2.2. OVERVIEW

1. *Ship watchkeeping practices using a propulsive plant simulator (PPS I)* course is designed to provide knowledge of the safe and efficient operation of the ship's machinery to watchkeeping engineers.

2. Upon successful completion of this course an applicant will receive a training certificate that is required to obtain one of the following certificates of competency or endorsement:
   a) Third-Class Engineer, Steamship or Motor Ship;
   b) Fourth-Class Engineer, Steamship or Motor ship;
   c) Watchkeeping Engineer, Motor-Driven Fishing Vessel;
   d) Maintenance Supervisor MOU/Self-Elevating

3. *Ship management practices taught using a propulsive plant simulator (PPS II)* course is designed to provide knowledge of corrective actions to be taken in problem solving in the recognition of signs and symptoms of a deteriorating function of ships machinery.

4. Upon successful completion of this course an applicant will receive a training certificate that is required to obtain one of the following certificate of competency or endorsement:
   a) First-Class Engineer, Steamship or Motor Ship;
   b) Second-Class Engineer, Steamship or Motor ship;
   c) Maintenance Supervisor, MOU/Surface
   d) Chief Engineer Endorsement, Steamship or Motor Ship;

2.3. COURSE ENTRY QUALIFICATIONS

1. *Ship watchkeeping practices using a propulsive plant simulator (PPS level I) cours*e.
   a) Entry to this course is open to individuals with basic marine background and knowledge and to marine engineers who wish to improve their knowledge and understanding of the operation and control of the machinery installation of a modern merchant ship. However, the following pre-requisites are to be complied with:
      i) An applicant has completed a minimum of 6 months of sea service performing duties related to an engineering position onboard a vessel or,
      ii) An applicant is registered with a Marine Engineer Cadet Training Program as define in TP 8911.

2. Ship management practices taught using a propulsive plant simulator (PPS-level 2) course.
   a) The following pre-requisites conditions are to be complied with:
      i) An applicants must have obtained a certificate of competency at a minimum level of a 4th class Engineer STCW endorsed
      ii) While holding at the minimum a certificate of competency at the 4th class Engineer level, an applicant must have completed a minimum of 6 months of sea service, as engineer in charge of an engineering watch or in charge of the machinery, onboard a vessel of at least 750 KW.

3. TRAINING COURSE APPROVAL

3.1. GENERAL

Canada's accession to the STCW Convention required that all approved marine training programs and courses to be delivered and monitored through a quality management system.

3.2. RECOGNIZED INSTITUTION

1. Engine room simulator-base courses are to be provided by a "recognized institution" as defined in the *Marine Personnel Regulations* (MPR). Approval procedures are provided in the chapter entitled Approval of Marine Training Courses and Programs of the Quality Management Manual – Marine Personnel Standards and Pilotage, published by the Department of Transport, Marine Personnel Standards and Pilotage Directorate.
2. A Provincial or Territorial Department or Ministry of education must have recognized the Recognized Institutions that wish to make an application for the delivery of engine room simulator-base courses.
3. Recognized Institutions must submit, 16 weeks prior to the beginning of the course, a letter of application and documents related to their course syllabus, training manual, instructor qualifications and other relevant information at the following address:

   Marine Personnel Standards & Pilotage
   att. Manager Engineering Certification (AMSPE)
   Transport Canada, Marine Safety
   330 Sparks Street
   Tower C. 8th floor,
   Ottawa, Ontario
   K1A 0N8

4. With the exception of a letter of application, documents related to the course syllabus, training manual, instructor qualifications and other relevant information can be submitted using an electronic media such as CD, DVD and USB flash memory data storage device.
5. Upon final approval; Recognized Institutions must provide, free of charge, 2 licensed copies of their engine room simulator-base's software. The licensed software will be used by Marine Personnel Standards & Pilotage branch and the closest TCMS district office for the purpose of review of assessment's scenarios.

3.3. INSTRUCTOR QUALIFICATIONS

1. Instructors teaching engine room simulator-base courses must hold, as a minimum standard, a Second-Class Engineer, Steamship or Motor ship Certificate of Competence.
2. Instructors must hold teaching qualifications incorporating training in instructional techniques, educational technology and evaluation methods.

3. Instructors must have completed training specific to the type of engine room simulator-base equipment used by the Recognized Institutions. Instructor's training must be delivered by a recognized engine room simulator-base expert.
4. Recognized Institutions must submit, 6 weeks prior to the beginning of the course, a letter of application for recognition of Instructors qualification to the AMSPE.

3.4. TEACHING ENVIRONMENT

Recognized institutions must provide suitable teaching environment and facilities that include:

a) Access to the course location to be easy and suitable.
b) Classrooms, lecture and study rooms suitable for the delivery of technical subjects.
c) Learning resource centre and library with sufficient marine texts to allow independent study on marine engineering subjects.
d) Room simulator-base, with full mission compartments.

3.5. COURSE ATTENDANCE

1. Recognized Institutions shall have a strict class attendance policy.
2. Students are to attend all classes, lectures and exercises to a rate of 90% attendance of the program.
3. Students with attendance levels less than indicated will not be considered as completing the courses and a Transport Canada Marine Safety Training Certificate will not be issue.
4. Recognized Institutions shall have a policy to assist students that have not met the expected attendance level by allowing extra time and special project.
5. Recognized Institutions shall limit the number of students attending the course to 8 students.

3.6. PASS/FAIL CRITERIA AND EXAMINATION METHOD

1. Final assessment by course instructor shall be as listed in STCW A I/12.8, that being;
   a) Performance criteria are identified clearly and explicitly and are valid and available to the student
   b) Assessment criteria are established clearly and are explicit to ensure reliability and uniformity of assessment and to optimize objective measurement and evaluation, so that the subjective judgements are kept to a minimum;
   c) Students are briefed clearly on the tasks and/or skills to be assessed and on the tasks and performance criteria by which their competency will be determined;
   d) Assessment of performance takes into account normal operating procedures and behavioural interaction;
   e) Scoring or grading methods to assess performance are used with caution until they have been validated; and
   f) The prime criterion is that a student demonstrates his/her ability to carry out a task safely and effectively to the satisfaction of the assessor.

2. All courses shall have sufficient evaluation of each student. As a minimum standard, an aggregate pass mark of 60% shall be required to successfully complete each course. The aggregate system of marking should be considered as follows:
   a) Assignments minimum = 20%;
   b) Mid Term Evaluation = 30%;
   c) Final Exam = 50%
3. The cumulative of all assignments including the mid-term exam accounts for 50% of the aggregate marking. The passing mark for each term work and for the mid-term examination is a minimum of 60%.
4. The final exam accounts for 50% of the aggregate marking. The passing mark for the final exam is a minimum of 60%.
5. The overall passing mark will be 60%
6. For the PPS Level II students there shall be written report with an aggregate value of 50% on the final mark.
7. For the examinations identified in (4) above, the pass/fail mark shall be 60%. Students not achieving the 60% pass mark or higher in each courses requirements shall be deemed as having failed the PPS Level I or PPS Level II Course as the case may be.
8. The examination process is illustrated under the course profile for either PPS1 or PPS2 and will be covered under different scenarios preapproved by TCMS.
9. Upon successfully completion of a course and examination, a candidate may be exempted for the requirements of PPS1 or PPS2 exam under the MPR.

3.7. TECHNICAL SPECIFICATIONS

1. Institutions must provide a Propulsion Plant Simulator meeting all the technical specification as described in Annex of this publication

4. SYLLABUS PPS LEVEL 1, WATCHKEEPING PRACTICES (LOW SPEED DIESEL ENGINES)

4.1. COURSE OUTLINE

Subject Area	Hours
Course Introduction	1
Familiarization • Plant arrangements • Instrumentation • Controls • Operational procedure	6
General procedures • Auxiliary units and systems • Diesel generator • Steam boiler • Steam turbo generator • Steam cargo turbine • Main-propulsion diesel engine	18
Main engine operation	8
Trouble-shooting	16
Watchkeeping • Duties associated with taking over and accepting a watch • Routine duties undertaken during a watch • Duties associated with handling over of a watch	28
Examination period • Briefing and debriefing (30 minutes) • Mid Term Evaluation (60 minutes) • Final Exam (90 minutes)	3
TOTAL	80

* ref TP2293 Sect 28.4; IMO Model Course, Engine Room Simulator, 2.07

4.2. DETAILED SYLLABUS

Knowledge, understanding and proficiency (Learning Objectives)	IMO/STCW Reference
1. COURSE INTRODUCTION	
The instructor shall:	
1.1. explain the scope and objectives of the course	
1.2. explain the relationship of this course to other courses within the subject area	
1.3. explain that use is made during the course of individual and group activities to develop skills and attitudes in preparing for future service	
1.4. explain the need to supplement what is learned with practical experience.	
1.5. explain what is required in order to reach each learning objective and pass each evaluation exercise	
2. FAMILIARIZATION	
2.1. Plant arrangements	
2.1.1 List the machinery and associated systems and equipment which form the simulated plant, such as: - Tanks - Valves - Pipe systems - Pumps - Heat exchangers - Oil treatment plant - Line filters - Electric generators (Diesel & Steam) - Main propulsion unit - Local controls - Distant controls	Table A-III/1 Operate main and auxiliary machinery and associated control systems Table A-III/1 Operate alternators, generators and control systems
2.1.2 Describe how the machinery and associated systems and equipment are arranged and linked together to form the plant, and compiles a block diagram illustrating this	
2.1.3 Describe the relationship between the block diagram and the plant mimic	

Knowledge, understanding and proficiency (Learning Objectives)	**IMO/STCW Reference**
2.2. Instrumentation	
2.2.1 Describe and lists the instrumentation used in the simulated plant to measure and indicate: - Pressure - Temperature - Fluid level - volume/mass (quantity) - Flow rate - Speed of rotation - Torque/power - Voltage - Current - CO2 content (of exhaust gases) - Pressure/volume in the engine cylinder (”Indicator diagram”)	
2.2.2 Describe the alarms that are used to indicate malfunctions and faults	A-III/1 Maintain a safe Engineering watch
2.2.3 Use the recorder to be able to demonstrate a cylinder P/V diagram (indicator card”) with the engine control at a specified power setting	
2.2.4 Be able to demonstrate: - Power output to shaft; - Cylinder mean effective pressure; - Power produced in cylinders; - Engine’s mechanical efficiency; - Specific fuel consumption in [kg/kWhour].	Table A-III/1 Operate main and auxiliary machinery and associated control systems
2.2.5 Be able to demonstrate the thermal data obtained to establish a heat balance	
2.3 Controls	
2.3.1 State that the machinery units forming the plant can be controlled from: - A position adjacent to the units in the engine room (local control); - A console in the control room (central control); - The bridge (bridge control).	Table A-III/1 Operate alternators, generators and control systems
2.3.2 State that operation of the main propulsion unit can be monitored from the instructor room, and faults introduced as required by the training programme	
2.3.3 State that the instructor room can also be used to issue commands for main engine power output to the control centre or to control the power output (bridge control)	
2.3.4 Demonstrate the use of controls from each location	

Knowledge, understanding and proficiency (Learning Objectives)	**IMO/STCW Reference**
2.4 Operational procedures	A-III/1 Operate main and auxiliary machinery and associated control systems A-III/1 Maintain a safe Engineering watch
2.4.1 State that safe practices must always be used when preparing machinery units and associated systems for start up and operation	A-III/1 Maintain a safe Engineering watch
2.4.2 Discuss the safe practices to be used for: - Opening and closing valves; - Starting and running pumps; - Operating water-circulation systems; - Admitting steam into a steam system; - Firing up an oil-fired boiler; - Filling oil tanks; - Operating centrifuges; - Keeping bilges empty; - Disposing of oil wastes.	A-III/1 Maintain a safe Engineering watch
2.4.3 State that as far as practicable a check-list should be used for all machinery units and systems when: - Preparing for use; - Starting up; - Entering normal operating mode.	A-III/1 Operate main and auxiliary machinery and associated control systems
2.4.4 Compile a Generic check-list for the preparation, start up and operation of an auxiliary machinery unit or system	A-III/1 Operate main and auxiliary machinery and associated control system
2.4.5 State the operational requirements for connecting an electric generator into the electrical system in the terms of: - Speed; - Voltage; - Frequency; - Synchronization.	A-III/1 Operate alternators, Generators and control systems
2.4.6 Demonstrate by the use of the simulated plant, a checklist and the procedures for: - The opening and closing of valves in a system; - The circulation of seawater; - Firing up the steam boiler; - Operating a fuel oil centrifuge; - Pumping out bilges.	

Knowledge, understanding and proficiency (Learning Objectives)	IMO/STCW Reference
3 GENERAL PROCEDURE OPERATION	
3.1 General procedures	A-III/1 Maintain a safe engineering watch
3.2.1 Observe and apply safe practices in all exercises	
3.2.2 Use checklists in all exercises	
3.2.3 Maintain a log of procedures and normal operating conditions for each exercise	
3.2 Auxiliary units and systems	A-III/1 Operating pumping systems and associated control systems
3.2.4 Prepare, start up, and put into the normal operating mode: - The seawater circulating system; - The freshwater circulating system; - The compressed air system; - The fuel centrifuge.	
3.3 Diesel generator	A-III/1 Operate alternators, generators and control systems
3.3.1 Prepare, start up, and run the diesel electric generator	
3.3.2 Synchronize, Parallel and load share	
3.4 Steam boiler	
3.4.1 Prepare and raise steam to normal working pressure	
3.4.2 Put the steam boiler on line	
3.5 Steam turbo generator	A-III/1 Operate alternators, generators and control systems
3.5.1 Prepare, start up and run the steam turbo generator	
3.5.2 Connect the turbo generator to the main electrical system, applying control on: - Voltage; - Frequency; - Synchronization.	
3.5.3 Demonstrate load sharing between diesel and turbo generators	

Knowledge, understanding and proficiency (Learning Objectives)	**IMO/STCW Reference**
3.6 Steam cargo turbine	A-III/1 Operate main and auxiliary machinery and associated control systems
3.6.1 Prepare, start and run the steam cargo turbine	
3.6.2 Operate the pump to discharge cargo	
3.7 Main-propulsion diesel engine	A-III/1 Operate main and auxiliary machinery and associated control systems
3.7.1 Apply preparation procedures, including: - Checking the seawater circulation through heat exchangers; - Checking the freshwater circulation through engine and heat exchangers; - Checking the lubricating-oil circulation through engine and heat exchangers; - Confirming that the engine turning gear is disconnected; - Checking the fuel oil circulation through heaters to injection pump inlets; - Confirming that compressed air is available for starting; - Confirming that the engine cylinder lubrication is functioning; - Turning the engine with starting air for one revolution with indicator cocks open.	
3.7.2 Apply preparation procedures, including: - Confirming that all indicator cocks are closed; - Confirming fuel oil circulation; - Confirming of bridge order for engine movement; - Application of starting air for 3-4 revolutions; - Moving fuel control to required speed position.	
3.7.3 Establish normal running mode and observe operating conditions, including: - Temperatures of lubricating oil and cooling water; - Temperatures of exhaust gas from each cylinder; - Temperatures of engine exhaust gas at inlet and exit from turbo charger; - Engine speed and power output; - Maintaining a check on fuel oil supply (service tank); - Maintaining a check on fuel viscosity and temperature; - Applying changes of engine speed and power as directed by the bridge and note changes in operating conditions.	

Knowledge, understanding and proficiency (Learning Objectives)	IMO/STCW Reference
4 MAIN ENGINE OPERATION	A-III/1 Operate main and auxiliary machinery and associated control systems
4.1 Prepare, start and run the main propulsion unit and associated systems	
4.2 Set the main propulsion unit controls to maximum full ahead sea power as directed from bridge control, or	
4.3 Apply manoeuvring procedures and use the controls to obtain required power outputs	
5 TROUBLE SHOOTING	A-III/1 Operate main and auxiliary machinery and associated control systems
5.2 Locate and apply remedial action for the following malfunctions or faults but not limited to: - Fuel injection timing (early/late); - Worn piston rings in one cylinder; - Fire in the scavenge air space; - Fouled turbo charger (exhaust side); - Fouled turbo charger (air side); - Fouled turbo charger air filters; - Fouled scavenge air cooler/ports; - Blackout; - Clogged auxiliary machinery oil filters; - Overheated main bearing; - Fouled heat exchanger surfaces; - Lubricating-oil circulation pump failure; - Flooded bilge sump; - Bridge control failure.	
6 MAINTAIN A SAFE ENGINEERING WATCH	A-III/1 Maintain a safe engineering watch
6.1 Duties associated with taking over and accepting a watch	A-VIII/2, part 4-2 Principles to be observed in keeping engineering watch
6.1.1 Enter the machinery space 15 minutes before the change of watch	
6.1.2 Inspect all operating units, noting operational conditions and any deviations from the normal mode	
6.1.3 Check steam boiler water level	

Knowledge, understanding and proficiency (Learning Objectives)	**IMO/STCW Reference**
6.1.4 Inspect bilge	
6.1.5 Note engine telegraph instruction and check engine control position and related speed	
6.1.6 Check quantities and levels in engine room service tanks	
6.1.7 Examine the engine room log	
6.1.8 Receive an oral report from the engineer officer in charge of the watch for the period of watch keeping now completed	
6.1.9 Enter in the engine room log any abnormal operational conditions noted during inspection	
6.1.10 Accept, if satisfied, responsibility for the machinery space operation	
6.2 Routine duties undertaken during a watch	A-VIII/2, part 4-2 Principles to be observed in keeping engineering watch
6.2.1 At regular intervals: inspect all operational machinery, noting operating conditions and correcting any deviations from the normal mode	
6.2.2 Operate the oil centrifuges as necessary	
6.2.3 Check the steam production plant periodically and adjust as necessary - CO2 content of exhaust gas - exhaust gas inlet and outlet temperatures if operating on waste heat	
6.2.4 The seawater temperature periodically and adjust the heat exchanger control valves in order to maintain the engine cooling water and lubricating oil within the correct operational range	
6.2.5 Check that the main engine cylinder lubrication is within the correct range	
6.2.6 Check the electrical system voltage and load and, if two or more generators are operating, that the load is properly balanced	
6.2.7 Check the pressure in compressed air storage tanks and top up	
6.2.8 Inspect bilge and under floor spaces and clear them using the bilge pump and complying with any anti-pollution regulations	
6.2.9 State that when serving on an actual ship the watch keeping routines and duties would also include responsibilities related to: - steering gear - propeller shaft casing and bearings - domestic freshwater - water for sanitary use	

Knowledge, understanding and proficiency (Learning Objectives)	IMO/STCW Reference
6.2.10 maintain the machinery space log book and know the significance of the readings taken	
6.3 Duties associated with handing over of a watch	A-VIII/2 part 4-2 "Principles to be observed in keeping an engineering watch",
6.3.1 Prepare an oral report to the relieving engineer officer in charge of the watch	
6.3.2 Not hand over the watch to the relieving officer if there is a reason to believe that the latter is not capable of carrying out the watch keeping duties	
6.3.3 Maintain the machinery space log book	

4.3. COURSE EXPECTATION

1. Upon completion the PPS Level 1 Course, the course participants will be able to perform Watchkeeping duties.
2. At the end of this course the participants will understand how to take over and handle an engine room watch and operate a power plant as if it is operated on-board a vessel.
3. The watch will be a minimum of one hour during that time; the Instructor will bring in malfunctions and change the machinery condition in order to keep the watchkeeper alert.
4. The Scenario might include various vessel operations such as: the vessel alongside under cargo operation, the vessel is berthing, leaving the dock or at sea
5. On completion of this course, the participants will know what is expected of a watchkeeper at sea, enabling him/her to be a valuable member of the engine room team.
6. Good Marine Engineering practises will be emphasised throughout the course, careful monitoring and operation of the ships' machinery will be stressed. Scenarios used in training runs will be as realistic as possible.

4.4. SIMULATOR EVALUATION CRITERIA

Plant Operation

The student must understand the operational procedures necessary for a ship's power plant safe operation and in accordance with the STCW Convention & Code requirements.

The Engineer of the Watch (EOW) shall be knowledgeable of the following process and criteria:

A. General Procedures

a) Safe practices: Ensure that the members of the engineering watch are fully capable of performing their duties effectively and apply safe work practices.

b) Checklists: Understand and operate the propulsion- and auxiliary plant status, while using checklists.

c) Maintaining the log: The state of completion of the engine room log shall reflect the work and changes that have been carried out.

B. Auxiliary units and systems start up and engage normal operation mode of:

a) the seawater system

b) the freshwater system

c) the air compressed systems

d) the lubrication oil system

e) the fuel oil system

f) the centrifuges

C. Diesel Generators: start up and engage normal operation mode of the diesel generators including proper synchronization and load sheering.

D. Steam boiler: start up and engage normal operation mode of the steam boiler and its sub systems.

E. Steam turbo generators start up and engage normal operation mode of the steam-driven generators including proper synchronization and load sharing

F. Steam cargo turbines; start up and engage normal operation mode of the steam cargo turbines.

G. Main propulsion: start up and engage normal operation mode of the main propulsion unit. Demonstrate operational modes, such as:

a) Bridge,

b) Local and Emergency Control, and react properly to Emergency Run,

c) Shut and Slow down of the main engine.

H. Attitude -The student shall be able to demonstrate:

a) Confidence, including the ability to learn from past mistakes and accept constructive criticism

b) Initiative, including the ability to identify problems and situations in advance and subsequently develops and implements solutions in a timely manner

c) Flexibility, including the ability to react to unexpected changes; and

d) Intensity (sense of urgency) including the ability to maintain control under stress and demonstrate an understanding of the degree of risk posed by various breakdowns or abnormal situations during navigation, ship handling and collision avoidance scenarios.

I. Safety

a) Demonstrate correct assessment of risk of equipment malfunctions or breakdown based on available information, while taking into consideration ship safety and emergency procedures and changeover from remote/automatic to local control of affected systems

Assess, plan and take necessary action to contain the effects of damage resulting from equipment breakdown, rupture, fire, or other causes.

Inform the bridge in the event of fire and of any impending action in machinery spaces that may cause reduction in the ship’s speed, imminent steering failure, stoppage of the ship’s propulsion system or any alteration in the generation of electric power or similar threats to safety.

Inform the Chief Engineer Officer

i) When engine damage or a malfunction occurs this may endanger the safe operation of the vessel.

ii) In any emergency or in doubt as to what decision or measures to take.

iii) Explain and always take into account the possibilities of hazards and prioritize the safety of human lives, over the marine environment and over damage to cargo and vessel

4.5. OFFICER TAKING OVER THE WATCH

The EOW shall be knowledgeable of the following process and criteria:

A. Watch Turnover Procedures

a) Personnel: Ensure that the members of the engineering watch are capable of performing their duties effectively

b) Machinery: Understand the propulsion- and auxiliary plant status including:
   i) The nature of all work being performed on machinery and systems, the personnel involved and potential hazards;
   ii) The level, and where applicable, the condition of water or residues in bilges, ballast tanks, slop tanks, reserve tanks, fresh water tanks, sewage tanks and any special requirements for use or disposal of the contents thereof;
   iii) The condition and level of fuel in the reserve tanks, settling tanks, day tanks and other fuel storage facilities;
   iv) The conditions of operation of the main propulsion plant and auxiliary equipments in polar waters and various ice conditions
   v) The condition and mode of operation of centrifuges;
   vi) Any special requirements relating to sanitary system disposals;
   vii) Condition and mode of operation of the various main and auxiliary systems, including the electrical power distribution system;
   viii) The condition of monitoring and control console equipment and which equipment that is manually operated.
   ix) The condition and mode of operation of automatic boiler controls and other equipment related to the operation of steam boilers
   x) The reports of engine room ratings relating to their assigned duties
   xi) The availability of fire-fighting appliances; and
   xii) The state of completion of the engine room log

c) Communications: Relevant communication passed and received from the bridge or other stations: e.g. bunkering, emergency stations including equipment status

d) Operations: The standing orders and special orders of the Chief Engineer Officer relating to the operation of the ship’s systems and machinery

e) Weather: Including any potentially adverse conditions resulting from bad weather, ice, or contaminated or shallow water

f) The student shall demonstrate:
   i) basic knowledge of and ability to use all engine room equipment relevant to the type of ship being simulated
   ii) effective working relationship with the engine room crew
   iii) effective supervision of engine room personnel
   iv) basic understanding of engineering principles
   v) Ability to select and utilize available information to keep the ship safe from danger by identifying possible hazardous situations or upcoming events and take the necessary precautions by:
      - Assessing the effects (ship movements) of wind, tide, ice conditions and current on the ship's propulsion machinery and auxiliary machinery, including presentation of valid solutions to maintain/regain safe operation
      - Using available information from external sources and observations of equipment in the engine room and other areas together with information obtained from alarm and monitoring systems to plan and schedule maintenance and other unforeseen, but necessary, actions required to maintain a safe and efficient operation of the ship
      - Meeting a scheduled arrival time and in this process demonstrating an appreciation of the importance of correct disposal of bilge, preparing for maneuvering, securing adequate reserve of power and steering gear equipment, taking into account fuel consumption considerations, and the requirement to achieve a pre-planned arrival
      - Being able to make correct and timely reports to the Bridge Officer and Chief Engineer Officer and follow their instructions
      - Recording and properly documenting all events, which have occurred during the watch, such as events related to main and auxiliary machinery, bunkering, oil transfer, waste or bilge disposal
      - Being able to promptly execute all bridge orders and record any changes in direction or speed of the main propulsion units; and
      - Supervising and using internal and external communications efficiently

B. Handling (Managing)

a) Take the actions necessary to contain the effects of damage resulting from equipment breakdown, fire, flooding, or other cause

b) Communicate any emergency or abnormal situation to the bridge, Chief Engineer Officer and other persons according to ship procedures

c) Demonstrate a basic knowledge of the main engine maneuvering characteristics

d) Demonstrate the ability to positively supervise ratings on the engineering watch and direct them to inform of potentially hazardous conditions; and

e) Demonstrate the ability to pay due attention to the ongoing maintenance and support of all machinery, their control apparatus, accommodation service systems and safety equipment

C. Attitude The student shall demonstrate:

a) Confidence, including the ability to learn from past mistakes and accept constructive criticism

b) Initiative, including the ability to identify problems and situations in advance and subsequently develops and implements solutions in a timely manner

c) Flexibility, including the ability to react to unexpected changes; and

d) Intensity (sense of urgency) including the ability to maintain control under stress and demonstrate an understanding of the degree of risk posed by various breakdowns or abnormal situations during navigation, ship handling and collision avoidance scenarios.

D. Safety:

a) Demonstrate correct assessment of risk of equipment malfunctions or breakdown based on available information, while taking into consideration ship safety and emergency procedures and changeover from remote/automatic to local control of affected systems

b) Assess, plan and take necessary action to contain the effects of damage resulting from equipment breakdown, rupture, fire, or other cause.

c) Inform the bridge, in the event of fire and of any impending action in machinery spaces that may cause reduction in the ship's speed, imminent steering failure, stoppage of the ship's propulsion system or any alteration in the generation of electric power or similar threat to safety.

d) Inform the Chief Engineer Officer and make recommendations to the Bridge Officer in the event of an engine damage or a malfunction occurs which may be such as to endanger the safe operation of the ship

e) Inform the Chief Engineer Officer in the event of:

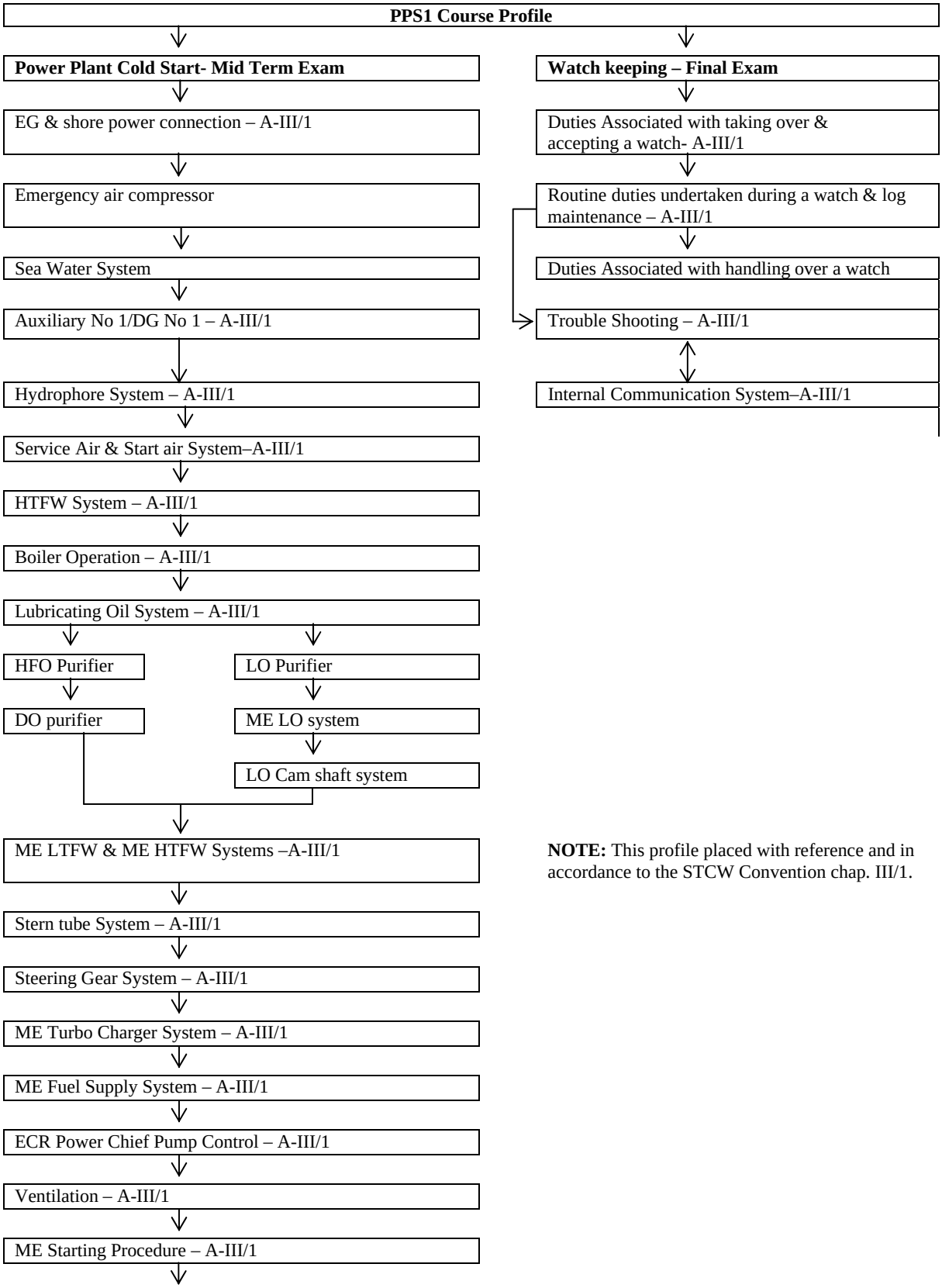
(i) any malfunction occurs, which is believed to cause damage or breakdown of propulsion machinery, auxiliary machinery or monitoring and governing systems; and

(ii) in any doubt about what decision to make or measures to take to rectify a situation

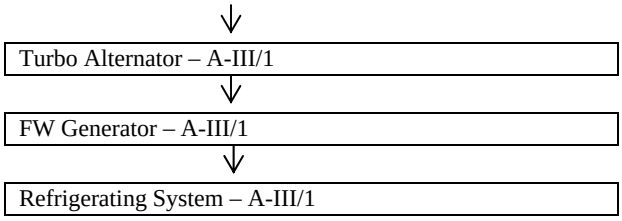
f) Demonstrate, the ability to assess an emergency situation and perform necessary emergency operation of propulsion machinery and auxiliary machinery

g) Take into account the possibilities of hazards and prioritize the safety of human lives, over the marine environment and over damage to cargo and vessel.

4.6. PROCESS FLOWCHART PPS1



NOTE: This profile placed with reference and in accordance to the STCW Convention chap. III/1.


Turbo Alternator – A-III/1
FW Generator – A-III/1
Refrigerating System – A-III/1

5. SYLLABUS PPS LEVEL 2, SHIP MANAGEMENT PRACTICES (SLOW SPEED ENGINES)

5.1. COURSE OUTLINE

Subject Area	Hours
Simulator Familiarisation and course introduction • Plant arrangements • Instrumentation • Controls • Operational procedure	7
Systems Setup • Auxiliary units and systems • Diesel generator • Steam boiler • Steam turbo generator • Steam cargo turbine • Main-propulsion diesel engine	14
Main engine operation	4
Trouble-shooting	16
Power plant and resources management practices • Written Report, reflecting the student's knowledge at the management level	16
Examination period • Briefing and debriefing (30 minutes) • Midterm Evaluation (60 minutes) • Final Exam (90 minutes)	3
TOTAL	60

Ref. TP 2293 Section 26.3

5.2. DETAILED SYLLABUS

Knowledge, understanding and proficiency (Learning Objectives)	IMO/STCW Reference
1. COURSE INTRODUCTION	
The instructor shall:	
1.1. explain the scope and objectives of the course	
1.2. explain the relationship of this course to other courses within the subject area	
1.3. explain that use is made during the course of individual and group activities to develop skills and attitudes in preparing for future service	
1.4. explain the need to supplement what is learned with practical experience.	
1.5. explain what is required in order to reach each learning objective and pass each evaluation exercise	
2. FAMILIARIZATION	
2.1. **Plant arrangements**	
2.1.1. List the machinery and associated systems and equipment which form the simulated plant, such as: - Tanks - Valves - Pipe systems - Pumps - Heat exchangers - Oil treatment plant - Line filters - Electric generators - Steam generators - Main propulsion unit - Local controls - Distant controls	
2.1.2. Describe how the machinery and associated systems and equipment are arranged and linked together to form the plant, and compiles a block diagram illustrating this	
2.1.3. Describe the relationship between the block diagram and the plant mimic	

Knowledge, understanding and proficiency (Learning Objectives)	**IMO/STCW Reference**
2.2. Instrumentation	
2.2.1. Describe and lists the instrumentation used in the simulated plant to measure and indicate: - Pressure - Temperature - Fluid level - volume/mass (quantity) - Flow rate - Speed of rotation - Torque/power - Voltage - Current - CO2 content (of exhaust gases) - Pressure/volume in the engine cylinder (”Indicator diagram”)	
2.2.2. Describe the alarms that are used to indicate malfunctions and faults	
2.2.3. Use the recorder to obtain a cylinder P/V diagram (indicator card”) with the engine control at a specified power setting	
2.2.4. Be able to calculate: - Power output to shaft; - Cylinder mean effective pressure; - Power produced in cylinders; - Engine’s mechanical efficiency; - Specific fuel consumption in [kg/kWhour].	
2.2.5. Use the thermal data obtained to establish a heat balance	
2.3. Controls	A-III/2 Manage the operation of propulsion plant machinery
2.3.1. State that the machinery units forming the plant can be controlled from: - A position adjacent to the units in the engine room (local control); - A console in the control room (central control); - The bridge (bridge control).	
2.3.2. State that operation of the main propulsion unit can be monitored from the instructor room, and faults introduced as required by the training programme	
2.3.3. State that the instructor room can also be used to issue commands for main engine power output to the control centre or to control the power output (bridge control)	

Knowledge, understanding and proficiency (Learning Objectives)	**IMO/STCW Reference**
2.3.4. Demonstrate the use of controls from each location	
2.4. Operational procedures	A-III/2 Operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery
2.4.1. State that safe practices must always be used when preparing machinery units and associated systems for start up and operation	
2.4.2. Discuss the safe practices to be used for: - Opening and closing valves; - Starting and running pumps; - Operating water-circulation systems; - Admitting steam into a steam system; - Firing up an oil-fired boiler; - Filling oil tanks; - Operating centrifuges; - Keeping bilges empty; - Disposing of oil wastes.	
2.4.3. State that as far as practicable a check-list should be used for all machinery units and systems when: - Preparing for use; - Starting up; - Entering normal operating mode.	
2.4.4. Compile a check-list for the preparation, start up and operation of an auxiliary machinery unit or system	
2.4.5. State the special requirements for connecting an electric generator into the electrical system in the terms of: - Speed; - Voltage; - Frequency; - Synchronization.	
2.4.6. Demonstrate the use of the simulated plant, a checklist and the procedures for: - The opening and closing of valves in a system; - The circulation of seawater; - Firing up the steam boiler; - Operating a fuel oil centrifuge; - Pumping out bilges.	A-III/2 Plan and schedule operation

Knowledge, understanding and proficiency (Learning Objectives)	**IMO/STCW Reference**
3. SYSTEMS SETUP	
3.1. General procedures	A-III/2 Plan and schedule operation
3.1.1. Observe and apply safe practices in all exercises	
3.1.2. Use checklists in all exercises	
3.1.3. Maintain a log of procedures and normal operating conditions for each exercise	
3.2. Auxiliary units and systems	A-III/2 Operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery
3.2.1. Prepare, start up, and put into the normal operating mode: - The seawater circulating system; - The freshwater circulating system; - The compressed air system; - The fuel centrifuge.	
3.3. Diesel generator	A-III/2 Manage operation of electrical and electronic control equipment
3.3.1. Prepare, start up, and run the diesel electric generator	
3.3.2. Couple, synchronize and load sheer	
3.4. Steam boiler	A-III/2 Operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery
3.4.1. Prepare and raise steam to normal working pressure	
3.4.2. Put the steam boiler on line	
3.5. Steam turbo generator	A-III/2 Manage operation of electrical and electronic control equipment
3.5.1. Prepare, start up and run the steam turbo generator	

Knowledge, understanding and proficiency (Learning Objectives)	**IMO/STCW Reference**
3.5.2. Connect the turbo generator to the main electrical system, applying control on: - Voltage; - Frequency; - Synchronization.	
3.5.3. Demonstrate load sharing between diesel and turbo generators	
3.6. Steam cargo turbine	A-III/2 Operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery
3.6.1. Prepare, start and run the steam cargo turbine	
3.6.2. Operate the pump to discharge cargo	
3.7. Main-propulsion diesel engine	A-III/2 Operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery A-III/2 Manage fuel, lubrication and ballast operations
3.7.1. Apply preparation procedures, including: - Checking the seawater circulation through heat exchangers; - Checking the freshwater circulation through engine and heat exchangers; - Checking the lubricating-oil circulation through engine and heat exchangers; - Confirming that the engine turning gear is disconnected; - Checking the fuel oil circulation through heaters to injection pump inlets; - Confirming that compressed air is available for starting; - Confirming that the engine cylinder lubrication is functioning; - Turning the engine with starting air for one revolution with indicator cocks open.	

Knowledge, understanding and proficiency (Learning Objectives)	**IMO/STCW Reference**
3.7.2. Apply preparation procedures, including: - Confirming that all indicator cocks are closed; - Confirming fuel oil circulation; - Confirming of bridge order for engine movement; - Application of starting air for 3-4 revolutions; - Moving fuel control to required speed position.	
3.7.3. Establish normal running mode and observe operating conditions, including: - Temperatures of lubricating oil and cooling water; - Temperatures of exhaust gas from each cylinder; - Temperatures of engine exhaust gas at inlet and exit from turbo charger; - Engine speed and power output; - Maintaining a check on fuel oil supply (service tank); - Maintaining a check on fuel viscosity and temperature; - Applying changes of engine speed and power as directed by the bridge and note changes in operating conditions.	
4. MAIN ENGINE OPERATION	A-III/2 Operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery
4.1. Prepare, start and run the main propulsion unit and associated systems.	
4.2. Set the main propulsion unit controls to maximum full ahead sea power as directed from bridge control.	
4.3. Apply maneuvering procedures and use the controls to obtain required power outputs.	
4.4. Apply and demonstrate the conditions of operation of the main propulsion plant and auxiliary equipments in polar waters and various ice conditions.	
5. TROUBLE-SHOOTING	A-III/2 Detect and identify the cause of machinery malfunctions and correct faults A-III/2 Manage trouble shooting, restoration of electrical and electronic control equipment to operating condition

Knowledge, understanding and proficiency (Learning Objectives)	**IMO/STCW Reference**
5.1. Locate and apply remedial action for the following malfunctions or faults not limited to: - Fuel injection timing (early/late); - Worn piston rings in one cylinder; - Fire in the scavenge air space; - Fouled turbo charger (exhaust side); - Fouled turbo charger (air side); - Fouled turbo charger air filters; - Fouled scavenge air cooler/ports; - Blackout; - Clogged auxiliary machinery oil filters; - Overheated main bearing; - Fouled heat exchanger surfaces; - Lubricating-oil circulation pump failure; - Flooded bilge sump; - Bridge control failure.	
6. POWER PLANT AND RESOURCE MANAGEMENT PRACTICES	A-III/2 Develop emergency and damage control plans and handle emergency situations
6.1. The candidate must prepare individually a written report in which he outlines a problem or situation that a plant manager might have to deal with under normal circumstances. 6.2. This report helps the assessor to evaluate the candidate's management skills and ability to manage, organize both a technical situations and manpower. This must include appropriate recommendations and solutions to the ship owners or other authorities.	

Knowledge, understanding and proficiency (Learning Objectives)	**IMO/STCW Reference**
6.3. Among the items to be outlined in the report are costs, fuel consumption, cause of the problem or situation and actions to resolve the problem or situation. 6.4. This written report must include the power plant technical management and may be consisted of one of the following criteria, but not limited to: - Piston Ring Wear on engine efficiency; - Exhaust Gas Boiler-Turbo Alternator on Propulsion Plant efficiency; - Hull Fouling on engine performance and fuel consumption; - Scavenge Air Port Fouling; - Cross head lubrication on engine performance; - Blow by on main engine; - Late and early injection timing; - Effect of engine room ventilation on propulsion engines; - Best fuel consumption; - Effect of hull fouling on fuel economy; - Effect of wear on the fuel injection equipment; - Cylinder peak pressures; - Fuel economy with different fuels (calorific value); - Air cooler fouling; - Turbocharger fouling; - Use of P, I and D settings on a specific PID controller; - Indicator cards; - Effect of different fuel viscosities on engine performance; - Effect of propeller size on plant efficiency; - Effect of water depth on plant efficiency; - Effect of static converter supply on fuel economy; - Resources management; - Any subject concerns power operation and maintenance management; - Any other related subject approved by the examiner	

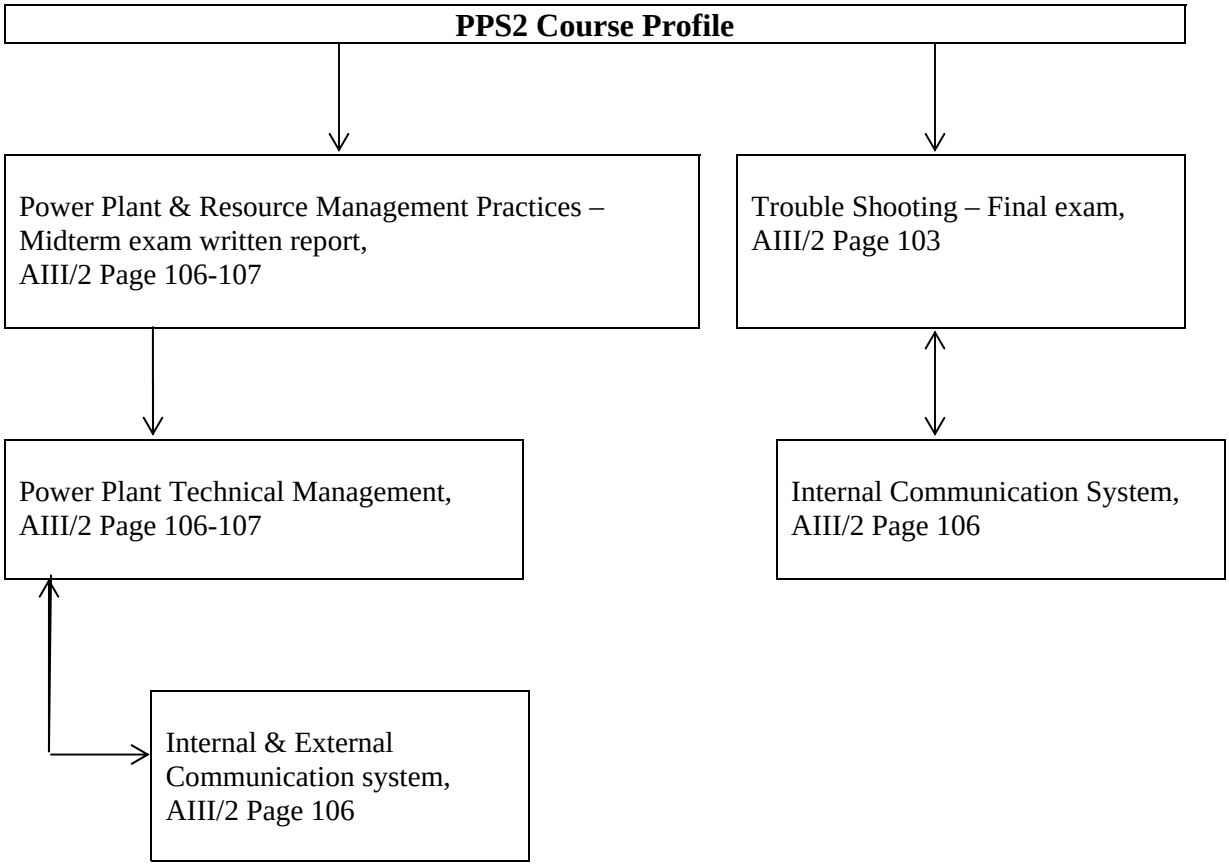
5.3. COURSE EXPECTATION

1. Upon completion this course, the participants will be able to demonstrate sound management practices.
2. At the end of this course, the participants will understand how to manage and organize operation of a power plant as implemented onboard a vessel.
3. The Scenario may include various vessel operations such as: the vessel alongside under cargo operation, the vessel is berthing, leaving the dock or at sea
4. Good marine engineering practises will be emphasised throughout the course, careful monitoring and operation of the vessels' machinery will be stressed. Scenarios used in training runs will be as realistic as possible.

5.4. SIMULATOR EVALUATION CRITERIA

1. Simulator Familiarization and course introduction
    a) Introduction to the configuration and basic functions of the simulator. Each separate system should have the capacity to stand-alone for segregated studies.
2. Systems Setup
    a) Setup procedure under normal and abnormal conditions, align, start and run all auxiliary and ancillary systems, start and run the main engine.
3. Main engine operation
    a) Prepare, start and run the main propulsion unit and associated systems
    b) Set the main propulsion unit controls to maximum full ahead sea power as directed from bridge control, or
    c) Apply maneuvering procedures and use the controls to obtain required power outputs
4. Troubleshooting
    a) The student will analyze symptoms and diagnose malfunctions, which could lead to major breakdown and damage to vessel's machinery.
5. Power plant and resources management practices
    a) Each candidate must prepare a written report in which he will outline a problem or a situation that a plant manager might have to deal with under normal circumstances.
    b) This report helps the assessor to evaluate the candidate's management skills and ability to manage and organize any technical situations.
    c) The report should include appropriate recommendations and solutions to the vessel's owners or other authorities.
    d) This report must be submitted to the assessor prior the completion of the training
    e) This report account for 50% of the final mark and is to be combined with the assessment resulted from the developed scenarios.
    f) It should be understand that a failure in any of these 2 assessments criteria will result in a course's failure.

5.5. PROCESS FLOWCHART



NOTE: This profile placed with reference and in accordance to the STCW Convention chapter III/2.

6. TECHNICAL SPECIFICATION FOR EQUIPMENT

6.1. PROPULSION PLANT SIMULATOR

1. Basic configuration of each simulator consists of an engine room, a control room, a plant management room, an instructor's station and a briefing/debriefing room.
   a) The engine room, a stand-alone unit, will be used to provide realistic exercises in the training of machinery operation, particularly designed for watchkeeping engineers on all vessels. This simulator is also the preparation level to the control room and remote monitoring training. The capabilities of the engine room simulator must be adequate to interface with the control room and remote monitoring simulators in order to interact by giving signals to or receiving signals and commands from the connected simulators.
   b) The control room, a stand-alone unit, used to provide realistic exercises in the training of machinery operation and monitoring from a centralized station, particularly designed for large ships with control room/machinery space configuration.
   c) The remote monitoring plant management unit is also stand-alone with the capability of interfacing with the engine room and control room units. This unit would contain personal computer stations, which use exercises of dynamic system programs.
   d) The instructor's station is a vantage point from which the instructor may monitor the student operating the simulator and at same time give the instructor the opportunity to alter by input the signs and symptoms of problems for the student. The instructors console is to give the instructor complete control of the simulators which would allow altering of exercise parameters, changing characteristics of ship or propulsion model, freezing of program, recording on diskette, printing out on paper or replaying on VDU of student exercises. The instructor's station and console must have the capability to act as the ship's bridge, with means of communication by telephone, telegraph, alarms and bridge control of propulsion system that would be found on a ship with manned or unmanned engine rooms.
   e) The briefing/debriefing room would contain in a class room setting a large screen visual display unit of the projection type which is to have the capacity of stand alone or to be interfaced with the simulators to enable class evaluation of exercise programs either concurrent with the student simulator operation or independently for class instruction.
2. Examination System; The examination system will incorporate the capability to prepare examinations at Marine Personnel Standards and Pilotage (AMSPE) which would be transferred electronically to the simulators. Results of examinations would be recorded on the individual candidate diskette for evaluation and storage.
   a) Realistic simulation is where the operator panels visually appear and operate identically to equipment in operational use.

b) Stylized simulation is where the front panel controls/indicators are functional but are not necessarily identical in appearance to equipment in operational use.

6.2. PERFORMANCE SPECIFICATIONS

The engine room/control room systems simulator must provide similar possibilities and constraints as experienced aboard a real ship for the operation and management of the propulsion machinery and related auxiliary machinery. The procedures to operate the equipment must be identical to those normally used at sea.

6.3. WATCH KEEPING

The engine room/control room systems simulator must provide similar possibilities and constraints as experienced aboard a real ship for:

a) the manual recording of machinery performance and

b) for manual diagnostics of system faults

6.4. ROUTINES

The normal and emergency routines of operating propulsion and related auxiliary/ancillary machinery must provide similar possibilities and constraints as experienced aboard a real ship such as for the manual and automatic transfer of generator loads, manual transfer of pumps, filters, fuel tanks and other equipment as set out in the particular sections on functions.

6.5. MANOEUVRING

1. In the presentation of realistic ship board experience the instructor will act as the officer of the bridge giving signals either for manual operation of the propulsion system, direction and speed, or for remote bridge control of that system. The manoeuvring of the simulated propulsion system must have the capability to be operated from a bridge simulator at a time of simulated combined simulator program.
2. The manoeuvring function must be activated from the instructor's console so that control of the propulsion system by the student can be allowed or inhibited, dependent upon the exercise parameters.

6.6. SYSTEM PARAMETERS

1. The simulated systems must present information to the student which is accurate and which is found in an on-board ship situation. The information must be comprehensive and sufficient to enable the student to diagnose problems of the individual or total propulsion/auxiliary system. The information presented by the simulator to the student must be validated by the machinery manufacturer and be for the engine machinery and propulsion system specified. The submitter is responsible for obtaining required data and certification from the engine manufactures.
2. Colour coding for wiring, alarm lights and piping systems must correspond to the International Standards Organization Standards specified in this document.

3. Instrumentation must be of the type and size found on board ship and be of the analogue type or digital type where this type is found in shipboard practice.

6.7. SIMULATOR FUNCTIONS

Engine Room

1. The simulated engine room equipment is to be microcomputer driven employing software, which by mathematical modelling represents the engine room system normally found on board a ship having a diesel engine propulsion system. It is the intent that the engine room, control room and plant/energy simulator systems will be of the stand alone configuration and have the capacity to interface with each other for total integrated plant operation exercises. It is expected that students will load exercises prepared by the instructor, carry out the exercises at their own learning speed and have the results of the exercise stored on the exercise disc for review by the instructor on either the instructor's personal PC or on the large screen projector. A hard copy of the exercise is to be available if required by the student, instructor or examiner.

2. The engine room is to be comprised at least the following equipment:

LEGEND:- R = REALISTIC, S = STYLIZED

a) Microcomputer with functional keyboard and diskette drive. The computer shall be capable of controlling the exercise (inserting malfunctions, freezing the exercise etc as programmed from the exercise diskette). (R)
b) Large scale stand alone mimic panel. (S)
c) Local subsystem control panels. (S)
d) Loudspeakers for the synthesized sound system. (R)
e) Visual display unit. (R)
f) Telephone system to connect engine room, control room, plant management centre and instructor's station. (R)

6.8. LARGE SCALE MIMIC PANEL

1. The large-scale stylized mimic panel is to represent the various engine room systems for a single screw propulsion system by distinctive colour outlining of each system in line/block diagrams. Each system is to contain the filters, header tanks, pressure gauges, pumps, strainer, temperature measuring devices, temperature controls, and valves essential to the operation of each system.

2. The mimic panel is to be interactive with facilities for local operation of pumps, valves, auxiliaries and main engine. The state of operation is to be indicated by lights (running lights, trip lights), and also by indicating instruments. Instruments should be of the analogue readout type and may be of the dual scale face to accommodate readings appropriate to the engine characteristics.

3. Colours for each system are to be in accordance with:
   a) Piping -- CCG-30-000-000-ES-TE-001
   b) Lights --ISO 2412-1982
4. The following items of machinery are to be included on the mimic panel:
   1. Characteristics are to be diskette loaded or selectable by instructor or by student exercise diskette, of two main engines, compression ignition, and mathematically modelled for:
      A. Medium speed 4 stroke, turbocharged in -line cylinders, non-reversible 500 to 650 rpm 2000 Kw continuous rating); and
      B. Slow speed 2 strokes, turbocharged engine, reversible 128 to 140 rpm, 9600 Kw continuous rating).
      C. Reverse and reduction gears with controllable pitch propeller systems matching engines. Clutch/engine/shafting engage characteristics should be modelled on a particular system compatible to engines. Should proposal include optional modelling of two medium speed diesels geared to single shaft, including load-sharing methods using governor models permitting operation in the droop or isochronous modes.
   2. The mimic panel is to display the systems interrelationship with the stylized local wall mounted panels, e.g.
      A. Bilge and ballast system
      B. Fuel storage system, including transfer, deep tank,
      C. double bottoms, settling tanks and day tank.
      D. Main engine local controls
      E. Main engine lubricating oil system
      F. Main engine cooling fresh water system
      G. Main engine cooling sea water system
      H. Main reduction gear lubricating oil system
      I. Main engine fuel oil blending system
      J. Main engine oil fuel system including fuel rack settings
      K. Main engine turbo-charging system
      L. Sea inlet and ship side valves
      M. System indicating lamps operated from wall panels, piping systems to have dynamic flow.

6.9. LOCAL PANELS

1. Stylized local wall mounted panels representing the various engine room systems on board are each to be fitted with start/stop (open/closed) buttons and running lights, gauges and controls as applicable. Features for resetting faults and simulating repairs are to be included on each panel. Panels are to be as follows:
   a) Air supply system for starting, control and service
   b) Ballast and bilge pumps with valves
   c) Bilge water/sludge purifier/separator
   d) Condenser system
   e) Controllable pitch propeller control system
   f) Cooling water pumps (sea and fresh)
   g) diesel generator no. 1
   h) diesel generator no. 2
   i) Diesel oil service tank system
   j) Diesel oil purifier
   k) Electrical switch-board with distribution system
   l) Emergency main engine telegraph
   m) Emergency generator outside engine room space
   n) Engine room fans and ventilation
   o) Auxiliary and exhaust boiler with load system
   p) Exhaust instrument system
   q) Fire pump and system
   r) Fresh water cooling control system
   s) Fresh water system
   t) Fuel oil tank system
   u) Fuel oil supply system
   v) Fuel oil heaters
   w) Fuel oil purifier - lubricating oil purifier
   x) Fuel oil transfer system
   y) Main engine control
   z) Main engine (cylinders)
   aa) Main engine exhaust instrumentation
   bb) Main fuel injection valves and injection pumps with rack setting
   cc) Main engine fuel valve cooling - piston cooling
   dd) Engine lubricating oil purifying system
   ee) Miscellaneous valves and pumps
   ff) Oil fired boiler

gg) Oil fired boiler system/misc. valves and pumps

hh) Sea water system

ii) Sea water return to sea bay for ice control

jj) Small ship electrical panel

kk) Steam system

ll) Steering gear control system

mm) Turbo generator

6.10. VISUAL DISPLAY UNIT

The high-resolution visual display unit located in the engine room is used for the presentation of alarms and inspection of the process model variables.

6.11. SYNTHESIZED SOUND SYSTEM EQUIPMENT

1. Four loudspeakers reproducing the simulated sound from the machinery are to be located in the engine room. The synthesized sound should produce simulated machinery sounds by means of a microprocessor based sound system.
2. At least five independent sound channels should reproduce the sound from at least the following sources:
   a) Pumps/fans/general engine room
   b) Diesel generators
   c) Main engine
   d) Turbochargers of the main and auxiliary diesel engines
3. The sounds from the main and auxiliary engines turbochargers should be synchronized with the speed and load of the engines.
4. The sound level in the simulated engine space is to be controlled by the instructor, in the range from no noise to a real engine room noise level. The high noise levels are to be those of a true engine space, which will require the use of ear protection.

6.12. PRIVATE INTERCOMS AND TELEPHONE SYSTEM

1. A telephone system to connect the engine room, control room and instructor's station is to be provided in order to provide simulation of on board communications between engine room and bridge.
2. The instructor's master station must be able to selectively and privately call and communicate with any sub-station. A sub-station need only privately call and communicate with the master station and with other sub-stations. Simplex operation (i.e., Press-to-Talk key operation) is acceptable. All stations must have a speaker (or ringer), handset and channel selector. The handset must have side tone. If a speaker is offered, it must be interlocked with the handset (via a cradle hook). The interlock action must inhibit the speaker when the handset is off-hook.

6.13. CONTROL ROOM

1. The simulated realistic control room is an extension of the engine room to be employed as a remote sensing and control centre for the propulsion machinery systems as found on-board today's diesel engine driven ships. The control room simulation units are to interface and operate the functions of the engine room and at the same time provide a link in the remote plant/energy management configuration. The control room also acts as the prime link in the bridge, control room/engine room and unmanned simulated operation mode.
2. Control Room Component - The control room is to contain at least the following:
   a) Microcomputer for stand-alone and interface
   b) Control console with instrumentation for:
      i) Remote operation of plant
      ii) Unmanned machinery space
      iii) Watch call system
   c) - Main electrical switchboard
   d) - Intra ship communications
   e) - Console for steam plant management
   f) - watch keeping data logger with hard copy printer
   g) - High resolution VDU with functional keyboard and disc drive
   h) - Console for alarm monitoring
   i) - Console for pump/compressor/electric generation automation
3. Student action panel for correcting faults is to be in the engine room space and interface with the mimic and local panels. The mimic and local panels may replace the student action panel.

6.14. SYNTHESIZED SOUND EQUIPMENT CONTROL

There shall be a minimum of two amplifiers for the synthesized sound system with all controls for the sound system in the instructor's control room.

6.15. VISUAL DISPLAY UNIT (VDU) INSTRUCTOR

A hi-resolution visual display unit is to be provided at the instructor's station as part of the general communications unit interfaced with the teleprinter.

6.16. ANALOGUE RECORDING OF PROCESS VARIABLES

At least a six-pen recorder is to be connected to the simulator computer. Any of the variable parameters are to be recordable as a function of time and a scaling range suitable for the parameters is to be selectable. Each pen is to have different colour ink for easy identification. The instructor uses the VDU or the teleprinter to communicate with the computer when changing recorder signals or scaling range.

6.17. PLANT/ENERGY MANAGEMENT

1. The plant/energy management system is to be primarily a stand alone system with interface to the engine room, control room and briefing/debriefing room. These systems are intended for use for individual exercises or for integrated total plant simulation.
2. The plant/energy management system is to comprise of at least the following compatible equipment:
   a) One microcomputer with graphic capability,
   b) Three high resolution (at least 1024 x 768 pixel) colour graphic display monitors with functional keyboards,
   c) Three text colour display monitors with functional keyboards,
   d) One instructor's high resolution (at least 1024 x 768 pixel) colour graphic display monitors with functional keyboard,
   e) Microcomputers to support the above display requirements.

6.18. PLANT/ENERGY MANAGEMENT DISPLAYS

1. The plant/energy management computer generated displays, with option of combining a selection of graphs in same display are considered to be a minimum requirement:
   a) Baseline and operational performance curves for specified engine
   b) Combustion process display
      i) Pressure vs crank angle
      ii) Rate of change of pressure vs crank angle
      iii) Valve lift vs crank angle
      iv) Fuel pump output pressure vs crank angle
   c) Rate of heat release vs crank angle

      Related variable parameters, not limited to:
      i) Cylinder pressure vs volume with BMEP, IMEP calculations Fuel specification change
      ii) Injection fouling
      iii) Excessive piston ring wear
      iv) Burnt exhaust valve
   d) Turbocharger operation display

      Related variable parameter, not limited to:
      i) Air inlet filter fouling
      ii) Atmospheric temperature changes including below zero conditions
      iii) Turbine blade fouling and graphic depiction of turbocharger surging
      iv) Compressor fouling

e) Controllable pitch propulsion system display

i) Related variable parameters, not limited to:
- Draft
- Hull fouling
- Propeller roughness (damage)
- Water depth
- Engine performance
- Etc.

2. The Module for the First Class Engineer level course shall contain at least five (5) interactive displays. The following three (3) interactive displays are required for the initial phase of the program. The submitter shall define the remaining two.
   a) Combustion Process Display
   b) Turbo-charger Operation Display
   c) Controllable Pitch Propulsion System Display
3. A brief description of these displays is provided below:
   a) Combustion Process Display - this display shall provide an animated computer-generated graphic illustration of the impact of changes in key combustion-related parameters of engine performance, particularly fuel consumption. It shall employ cut-away perspective of the diesel engine combustion chamber with pertinent animation of cylinder motion, change in nozzle spray patterns, piston ring blow-by, etc. The independent related parameters should include, but not be limited to:
      i) Fuel specification changes
      ii) Injection fouling
      iii) Excessive ring wear
      iv) Burnt exhaust valve
   b) Turbo Charger Operation Display - This display shall provide an animated computer generated graphic illustration of the impact of changes in key turbo-charger parameters on engine performance, particularly fuel consumption. It shall employ a cut-away perspective of both the exhaust gas turbine and the charge air compressor with pertinent animation of turbine/compressor rotation; exhaust gas/change air flow, etc. The independent combustion related parameters shall include, but not be limited to:
      i) Air inlet filter fouling
      ii) Atmospheric temperature changes
      iii) Turbine blade fouling
      iv) Compressor fouling

c) Controllable Pitch Propulsion System Display - This display shall provide an animated computer-generated graphic illustration of the operation of a controllable pitch propulsion system under various conditions of draft, hull fouling, propeller roughness, water depth, injector fouling, etc. It shall employ a medium speed diesel engine or slow speed engine operating diagram with specific fuel consumption contours. The propeller load line and resulting engine operating point shall be over/and on a diagram and shall respond to the various operational conditions identified above. At any engine operating point, engine RPM, BHP, and SFC will be clearly presented.

6.19. PROCESS ANALYSIS STATION

1. The integrated multicolour process analysis station must consist of three (3) student positions with high-resolution monitors (1280 x 1024 pixel minimum) with keyboard for graphic presentation and an instructor communication VDU with keyboard.
2. Each workstation must have authoring capability to allow either the instructor or student to modify both the graphic presentation and analysis parameters and to store the results for use during future exercises.
3. The instructor shall have the capability to configure the workstations such that:
   a) Each workstation forms a separate independent simulation facility, controlling and displaying the simulator of one subsystem or one component.
   b) All workstations can be used to observe the ongoing simulation of the ship's total machinery with all auxiliary systems.

6.20. BRIEFING/DEBRIEFING ROOM

1. The briefing/debriefing room equipment is to have the capability to interface with the simulators or to stand alone for separate exercises, function at the same time as exercises are in progress on the simulators repeating the student activities and to playback the student exercise to assist in the correction of errors in procedures.
2. The briefing/debriefing room equipment is to comprise of at least the following compatible equipment:
   a) One large projection screen
   b) One high-resolution large screen projector
   c) One VHS, NTSC standard video recorder/player
   d) One microcomputer with functional keyboard and disc system to support the above display requirements

6.21. INSTRUCTOR/ EXAMINER'S FACILITIES

1. The instructor and examiner shall be provided with a composite set of facilities which will effectively enable them to prepare exercises in advance, to supervise exercises in progress and to debrief the trainee at the close of an exercise. These facilities shall include an interactive command and control terminal (with possibly an integral plan view display), intercom, and a debriefing facility. The overall design and integration of this instrumentation must emphasize the importance of not overloading the instructor with exercise controls duties to the detriment of trainee instruction. Ease of entry and retrieval of information must be expeditious and straightforward with structured prompt and paging sequencing procedures
2. The instructor's station room is to be comprised of the following:
    a) Instructor’s console
    b) Electronic printer
    c) Engine room sound control equipment
    d) High-resolution (at least 1024 x 768 pixel) compatible visual display unit with functional keyboard.
    e) Electronic PID controller
3. The instructor's console is to be divided into two sections, the manoeuvring section and the communication section. The manoeuvring section will permit the instructor to exercise remote control of the main engine as a "bridge officer", giving the student manual manoeuvring commands. The communications section permits the instructor to perform simulation control, general system communication, entering faults, setting/ changing of operational and ambient conditions, engine characteristics, and freezing of exercise.
4. The hard copy printer of letter quality and the computer keyboard is to be part of the instructor's equipment to enable him to set and reset faults, receive information about all attempts in fault resetting done by student, and to enter changes in system parameters. The hard copy printer is to be used also for the operation of the analogue recorder and the PID controller and further used as an event log and alarm log to provide a hard copy print out for student results and record of progress

6.22. EXAMINATION/STUDENT ASSESSMENT SYSTEM

1. The examination development station is to consist of the same hardware as the student assessment station with the following exception: the system compatible microcomputer shall have additional memory and other capabilities necessary to support the examination authoring language and long term data collection and statistical analysis programs.

2. The assessment system shall consist of dedicated personal stations with two similar but slightly different hardware configurations although compatible with each other. The student assessment stations will be located with each of the five simulators while the master station is to be located at Marine Safety Marine Crew and Training Headquarters, Ottawa.
3. The local assessment station is to evaluate the results of the examination held on the simulator and interface with a hard copy printer to assist in calling up the events carried out by the candidate for debriefing and review of the examination.
4. The Master unit will provide the means to program examination exercises on diskette for distribution to the examiners at the local centres and to enable headquarters to evaluate and analyze results. Headquarters will be the repository of examination results and diskettes. Changes to the examination program or results will be carried out only at H.Q.
5. The Examination/Student Assessment Systems are to comprise of at least the following compatible equipment
    a) One high resolution (1024 x 768 pixel) colour graphic display monitor.
    b) One high quality mouse control/pointing device.
    c) Microcomputer system with appropriate disc system and functional keyboard.
    d) One high quality monochromatic hard copy printer.