Directorate General of Shipping, Ministry of Shipping, Govt. of India, Mumbai

Authorized by the Directorate General of Shipping, GOI	Examination, Assessment & Certification (EAC) Branch& Training Branch	IS/ISO Clause No.7.5.1
	Subject: Mandatory Guidelines for Maritime Training Institutes for obtaining approval to conduct High Voltage Safety & Switch Gear (Management level) course.	Training Circular No.04 of 2017
	File No:- ENG/MISC-29(7)/2016 & TR/POL/8(2)/17	Dated: - 01.02.2017

1. In continuation with the various circulars issued by the Directorate with respect to Training required for the Electro-Technical Officers (ETO) & Engineers under operational & management level, the Directorate now sets the guidelines for **"Mandatory Guidelines for Training Institute for obtaining approval from Directorate General of Shipping to conduct High Voltage Safety and Switch Gear (Management level) Course ID: 169"**, which is available in the attachment with the circular.

2. From now onwards 08 hours training course for Operational level will remain as a "stand-alone course" if necessary with maximum 24 candidates per batch for theoretical classes and maximum 12 candidates per batch for practical classes. These 24 candidates may be split into two groups each group with12 candidates for imparting practical training separately.

3. Details of the Guidelines of "High Voltage and safety switch gear course" may be found with the attachment.

4. The same is applicable with immediate effect to all the approved Maritime Institute qualified for imparting the High Voltage and Safety Switch Gear for both Operational & Management level.

5. This issue with the approval of the competent authority of the Directorate General of Shipping.

A.B. Dutta)
D-DG(Tech)

To,

1. All Maritime Training Institute
2. Principal Officers, MMD, Mumbai/Chennai/ Kolkata/ Kochi/ Kandla
3. Shipping Masters, Mumbai/ Kolkata/ Chennai
4. INDOS Cell, DGS, GOI, Nau Bhavan Building, Mumbai-1
5. Nautical Branch, DGS, GOI
6. Engineering Branch, DGS, GOI
7. Training Branch
8. Hindi Cell (To translate in Hindi and put up in website
9. INSA/ FOSMA/ MASSA/ ICSSA/ MUI/ IMEI/ CMMI/ NUSI
10. Computer Cell, DGS, GOI with a request to upload this on the official website
11. E-governance Cell, DGS, GOI
12. Guard File
13. Sr. PS to DG(S) for information
14. Sr. PS to Addl. DG (S) for information
    Sr. PS to CS/NA for information

MANDATORY GUIDELINES FOR TRAINING INSTITUTES
FOR OBTAINING APPROVAL FROM DIRECTORATE GENERAL OF SHIPPING

TO CONDUCT

HIGH VOLTAGE SAFETY AND SWITCH GEAR (MANAGEMENT LEVEL)

COURSE ID: 169

To avoid unnecessary repetition, reference has been made herein to DGS Order no: 5 of 2016 (Guidelines for the conduct of Post-Sea Training courses) wherever appropriate

TABLE OF CONTENTS

BASIC DETAILS OF THE COURSE

1.1. AIMS:

The aim of the course is to provide Marine Engineering and Shipboard Electrical personnel, the necessary education and training in the operation and management of electrical power plants above 1000 volts, to meet the Knowledge, Understanding and Proficiency (KUP) requirements set out in the specific part of the STCW Section A-III/2,Table A-III/2and Section A-III/3 at the management level and Section A-III/6,Table A-III/6 at the operational level, as given in the STCW convention and code as amended in 2010.

1.2. Objective

This training is applicable to Marine Engineer Officers with relevant Certificate of competency and Electro Technical Officers for the management level course; junior Marine Engineers for Operational level course; working on ships powered by main propulsion machinery above 750 kW and having onboard, electrical installations of above 1000 volts.

The objective of the training is the safe operation and management of high voltage systems onboard and their associated switch gear. The trainee shall be able to understand the HV/LV power systems including statutory regulations, hazards associated with high voltage systems, be able to safely operate and maintain such systems. The trainee shall also be able to perform HV switching operations on a wide range of marine and offshore power equipment, as well as carry out isolation, fault diagnosis and troubleshooting.

2. QUALIFICATION & ELIGIBILITY OF STUDENTS

2.1. Entry standards

The following officers are eligible to attend the Management Level course:

2.1.1 Marine Engineering officers holding as a minimum:

- a MEO Class IV (FG / NCV) certificate of competency and has completed a minimum of 12 months sea going service as a certificated Engineer Officer of watch OR
- a MEO Class I/II (FG / NCV) certificate of competency OR
- a Dredge Grade I/II certificate of competency

2.1.2 Electro-technical officers holding as a minimum,

- a Certificate of Competency as "Electro-Technical Officer" issued by the Govt. of India; OR
- a certificate of course completion, having successfully completed an approved ETO Pre-sea training course and has completed approved seagoing service to be eligible for appearing for ETO Certificate of competency examination; OR
- a record of sea going service of not less than 12 months in the capacity of ETO / Electrical Officer / trainee E/O to be eligible for appearing ETO Certification of Competency Examination.

2.2. Required attendance:

100% attendance is required for successful completion of the course.

However, in exceptional circumstances, a trainee is allowed absence of up to one day subject to his attending the lectures missed out during the subsequent course at the same institute, within a maximum period of three months. The institute shall keep proper records of such cases.

2.3. Course intake limitations

(i) Maximum 12 trainees per batch for Practical Training Classes.
(ii) Maximum 24 trainees per batch for Theoretical Training Classes.

3. INFRASTRUCTURE REQUIREMENT

3.1. Teaching facilities and equipment

Training center's seeking approval will need to demonstrate availability of suitable facilities for practical, general and theoretical instruction, appropriately equipped with teaching and learning aids and designed to enable each learner to fully engage in the learning process. All facilities must be maintained and where appropriate, inspected and tested in accordance with applicable regulations, current standards and manufacturers recommendations.

A. Classroom

Class room shall be of minimum area as specified in DGS order 5 of 2016, Post Sea Training course guidelines and equipped with a white / black board, overhead / LCD projector / Video player/ PC/Laptop.

B. High Voltage Lab

A laboratory containing the High Voltage equipment for practicals and demonstrations.

The equipment may be installed in the classroom for High voltage course provided that the area is sufficient for both lecture delivery and practical demonstrations.

The teaching aids required are mentioned under paragraph 14.

C. Visit to a High Voltage Facility

The institute shall have a tie-up with a High Voltage electrical facility which is using voltages over 1000V, so that the trainees can be shown live demonstration of energizing the high voltage switchboard and the arcing phenomenon.

This tie-up and visit is not required if the institute can provide high voltage (greater than 1000V) at the bus-bar on the switchboard fitted at the institute.

4. COURSE DETAILS

4.1. Course Duration: 5 days (40 hours) including practical and assessment

4.2. Course Outline: As per Annexure 2

5. HOLIDAYS

5.1. Sundays shall be holidays.

5.2. Independence Day (15th August) and Republic Day (26th January) shall be compulsory holidays.

5.3. Students shall normally enjoy the holidays observed by the Government of the state in which the institute is located.

6. FACULTY REQUIREMENT

6.1. Qualifications and experience of Training Faculty:

6.1.1 Course In-charge shall

- hold Certificate of competency MEO Class I (FG) issued or recognized by the Government of India, AND
- have not less than 5 years of sea going service onboard merchant vessels above 3000 kW, AND
- has undergone an approved High Voltage Safety and Switch Gear management level course and / or High Voltage trainer's course.

6.1.2 The faculty shall

- Hold a Certificate of competency MEO Class I (FG) issued or recognized by the Government of India, AND
- Have not less than 4 years of sea going service onboard merchant vessels above 3000 kW, AND
- has undergone High Voltage Safety and Switch Gear course and / or High Voltage trainer's course

  OR

- Qualified as Electrical Officer and having not less than 6 years of sea going service as Electrical officer on Merchant ships; AND has undergone High Voltage Safety and Switch Gear management level course and / or High Voltage trainer's course

  OR

- B. Tech/B.E. or equivalent degree in Electrical Engineering with not less than 1 year High Voltage industrial experience.

  OR

- Indian Navy Officers / Chief Petty Officers from electrical branch with not less than 6 years experience on Naval ships; AND has undergone High Voltage Safety and Switch Gear management level course and / or High Voltage trainer's course

6.2. Training of Trainers & Assessors Course:
As per DGS Order no: 5 of 2016.

6.3. Visiting faculty:
Qualifications and experience of visiting faculty members should be the same as that of full time faculty as specified above.

6.4. Age limit for regular faculty members:
As per DGS Order no: 5 of 2016.

7. FACULTY TEAM

7.1. Not less than two faculty, of which one is the course-in-charge

7.2. Minimum of 50% of the entire portion must be covered by full time faculty.

8. COURSE DURATION

A total of 40 hours of lectures practical training and assessment for Management Level.

9. ASSESSMENT

To be deemed pass in the course, the student shall meet the following requirement.

1. Minimum classroom / practical session attendance required is 100%. However relaxation of attendance may be granted in exceptional circumstances as per prevailing DGS guidelines.
2. Assessment shall be conducted by way of a written test.
   Objective Type theory paper: Pass Percentage 50%.Practical exercises / demonstration may also be one of the assessment methods.

Assessment must be organized so that learners can, through demonstration and examination, show that they meet the competence requirement as specified in STCW Tables A-III/2 and A-III/6 criteria for evaluating competence in column 4 of the tables.

The assessment system, methods and practice must be valid, reliable and authentic.

10. QUALITY STANDARDS

As per DGS Order no: 5 of 2016.

11. INSPECTIONS

As per DGS Order no: 5 of 2016.

12. COST OF INSPECTIONS

As per DGS Order no: 5 of 2016.

13. FEES TO GOVT.

As per DGS Order no: 5 of 2016.

14. TEACHING AIDS

A. Teaching Aids

A1 OHP or LCD Projector

A2 Computers

A3 Video player/Compact disc

A4 High voltage Personal Protective Equipment - 1 each

- High voltage boots
- HV arc flash protection suit with Hood with face shield.
- UV filter goggles.
- Rubber Gloves Class 2

All the PPEs must be of approved type and of industry standards.

A5 High Voltage Lab Equipment

- High voltage insulation resistance tester (at least 5kV rating)
- High voltage detector
- High voltage switchboard panel units rated at 6.6 KV or above, having bus bar, vacuum circuit breaker or SF6 circuit breaker with associated 'protection relay' systems. The panels are to be fitted with the necessary instrumentations, PT, CT systems and the interface for operation of the switchgear including indication lamps and meters. The panel must also have circuit main earthing arrangement. Participants should have experience in withdrawing the breaker from the panel, which is included in the practical session. They should be able to demonstrate safe earthing, "key safe" procedure and safety lock out devices.
- Vacuum electromagnetic contactor for high voltage systems
- Portable earthing cable and grounding assembly, at least two sets
- Insulated hand tool kit
- Insulation testing facilities on an Electrical motor
- High voltage to Low voltage steps down transformer and facility to carry out PI test.
- Variable frequency drives used in marine installations.
- High Voltage Electrical cables

B. IMO References

1. SOLAS 1974, International Convention for the Safety of Life at Sea, 1974 (SOLAS 1974), latest Consolidated Edition, (IMO-II0E)
2. International Convention on Standards of Training, Certification and Watch-keeping for Seafarers, STCW as amended in 2010, including subsequent amendments.(IMO-938E)
3. IMO Model Course 7.08, Ed. 2014 – Electro-Technical Officer
4. IMO Model Course 7.02, Ed. 2014 – Chief Engineer Officer and Second Engineer Officer

C. Reference Books

1. Practical Marine Electrical Knowledge, by Dennis T.Hall, Witherby Seamanship International
2. Ship's Electrical Power Distribution Diagram for high voltage system
3. Competency in Marine Electrical Engineering – 2015, by J. Majumder and Elstan A. Fernandez
4. High Voltage Engineering by M. S. Naidu and V. Kamraju
5. High Voltage Engineering Fundamentals by Kuffel
6. Introduction to High Voltage Engineering by Subir Ray

D. Other Textbooks (non-mandatory) :-

1. A textbook on Electrical Technology volume 2 – 1999 B. L Theraja, S. Chand & Co. Ltd.
2. A textbook on Electrical Technology volume 3 – 1999 B. L Theraja, S. Chand & Co. Ltd.
3. REED's Volume 7: Advanced electro-technology for engineers, 2nd Edition 2008 KRAAL, E.G.R. London, Adlard Coles Nautical
4. REED's Volume 6: Basic electro-technology for engineers; 1985, Thomas Reed Publications E. G. R. Kraal, Publisher: ISBN: 0900335963
5. Ship Automation for Marine Engineers and ETOs – by Alexandr Yakimchuk, Witherby Seamanship International.

E. Recommended Videos:-

1. Practical Marine Electrical Knowledge – Part – 7 (Electrical survey equipment) - Videotel
2. Practical Marine Electrical Knowledge – Part – 8 (Electrical Propulsion and High Voltage Practices)- Videotel

ANNEX 1

IMO Model Course 7.02, Ed. 2014

Chief Engineer Officer and Second Engineer Officer

Function 2: Electrical, electronic and control engineering at the management level

Competence 2.1: MANAGE OPERATION OF ELECTRICAL AND ELECTRONIC

CONTROL EQUIPMENT *THEORETICAL KNOWLEDGE*

2.1.4 DESIGN FEATURES OF HIGH-VOLTAGE INSTALLATIONS

Required Performance:

.1 Design features of high-voltage installations (20 hours)

- Generation and distribution of high voltage on ships
- Electric propulsion system
- Synchro-convertors and cyclo-convertors
- Functional, operational and safety requirements for a marine high voltage system
- Assigning qualified personnel to carry out maintenance and repair of High voltage switchgear of various types
- High voltage system advantages
- Advantages of an insulated system
- High voltage circuit breakers
- High voltage cable
- High voltage fuses
- Remedial action necessary during faults in a high-voltage system
- Switching strategy for isolating components of a high- voltage system
- Selection of suitable apparatus for isolation and testing of high-voltage
- equipment
- Switching and isolation procedure on a marine high-voltage system,
- complete with safety documentation
- Performance of insulation resistance and polarization index on highvoltage
- equipment

2.1.4.1 Design features of high-voltage installations (20 hours)

Instructors should consult T14,T58 and V20 for :
(i) Generation and distribution of high voltage on ships (ii) Electric propulsion system (iii) Synchro-convertors and cyclo-convertors(iv) Functional, operational and safety requirements for a marine high voltage system (v) Assigning qualified personnel to carry out maintenance and repair of high-voltage switchgear of various

types (vi) High voltage system advantages (vii)Advantages of an insulated system (vii) High voltage circuit breakers (viii) High voltage cable (ix) High voltage fuses (x) Remedial action necessary during faults in a high-voltage system (xi) Switching strategy for isolating components of a high voltage system (xii) Selection of suitable apparatus for isolation and testing of high voltage equipment (xiii) Switching and isolation procedure on a marine high-voltage system, complete with safety documentation (xiv) Performance of insulation resistance and polarization index on high-voltage equipment.

STCW Section B-III/2

Guidance regarding training of engineering personnel having management responsibilities for the operation and safety of electrical power plant above 1,000 volts

1 Training of engineering personnel having management responsibilities for the operation and safety of electrical power plant more than 1,000 V should at least include:

.1 The functional, operational and safety requirements for a marine high-voltage system;

.2 Assignment of suitably qualified personnel to carry out maintenance and repair of high-voltage switchgear of various types;

.3 Taking remedial action necessary during faults in a high-voltage system;

.4 Producing a switching strategy for isolating components of a high-voltage system;

.5 Selecting suitable apparatus for isolation and testing of high-voltage equipment;

.6 Carrying out a switching and isolation procedure on a marine high-voltage system, complete with safety documentation; and

.7 Performing tests of insulation resistance and polarization index on high-voltage equipment.

IMO Model Course 7.08, Ed. 2014

Electro-Technical Officer

Function 1: Electrical, Electronic and Control Engineering at the Operational level

Competence 1.1 Monitor the Operation of Electrical, Electronic and Control Systems

1.1.11 APPRECIATIONS OF THE HAZARDS AND PRECAUTIONS REQUIRED FOR THE OPERATION OF POWER SYSTEMS ABOVE 1,000 VOLTS

Required performance

11.1 Hazards and Precautions Required for the Operation of Power Systems Above 1,000 Volts (5 hours)

- explains relation between shock voltage and shock current
- explains the possibility of distance electrical shock
- explains the possibility of the electrical shock by the electrostatic charge
- explains the influence of shock current on human body
- explains the difference of electric shock caused by low and high voltage
- understands meaning of warning signs
- understands the possibility of essential lengthening and migration of electric arc at the voltages above 1kV
- explains basic parameters of electric arc: the temperature, the energy etc.

Competence 1.4: OPERATE AND MAINTAIN POWER SYSTEMS IN EXCESS OF 1,000 VOLTS

1.4.1 HIGH VOLTAGE TECHNOLOGY

Required performance:

1.1 High Voltage Technology (15 hours)

- explains nature and forming of electric stresses in general, electric stresses in laminar structures and HV insulation structure
- explains the break-down strength of gases, discharge development in gases, critical voltage and stress, partial discharges, static and impulse air break-down strength, low and high pressure-gases insulation system break-down strength
- explains the break-down strength of solid dielectrics, discharge mechanism in solids
- describes the break-down strength of operation insulation systems, high voltage insulation systems on ships
- describes the general overvoltage characteristics, short-circuit and weak reactive current switching overvoltage
- explains the ageing of electrical insulation

- describes the circumstances causing development of high voltage power systems on ships
- explains construction and operation of HV equipment:
  - circuit breakers, vacuum type and pressurised gas type (SF6) for arc quenching, fuses, over current protection etc.
  - electrical machines: motors, generators, transformers
  - switchboards
  - instrumentation
- describes overvoltage protection, protectors and arresters, insulation systems coordination, voltage disturbances and threats elimination

1.4.2 SAFETY PRECAUTIONS AND TECHNOLOGY

Required performance:

2.1 Safety Precautions and Technology (5 hours)

- explains and describes general HV protection measures: housings, partitions, distances, insulation mats, insulation materials, access restrictions, markings and warnings, HV equipment access monitoring and locks
- explains and describes how to use fixed and portable HV measurement and control apparatus for testing insulation resistance of HV machines, cables and another equipment,
- explains how to check and use HV testers

1.4.3 ELECTRICAL PROPULSION OF THE SHIPS, ELECTRICALMOTORS AND CONTROL SYSTEMS

Required performance:

3.1 Electrical Propulsion of the Ships, Electrical Motors and Control Systems (15 hours)

- describes advantages of ship electrical propulsion
- presents configurations of electrical propulsion:
  - Electric Propulsion Systems with classic shaft lines
  - Podded Propulsion Systems
- draws up general block diagram of electrical propulsion system with all main components
- states High Voltage Supply and Power range of electric propulsion systems used on ships
- describes main features of electric motors used in Main Propulsion systems:
  - types of electric motor
  - mechanical construction
  - excitation
  - motor cooling
- describes propulsion supply equipment:
  - transformers (air cooled and liquid cooled) with protection
  - slip rings with arc monitoring circuit
- names types of frequency drives used in main propulsion systems, draws up their block diagrams and explains main features:
  - Frequency Converter (with current source inverter and voltage source inverter)
  - Cycloconverter
- names methods of electric motor control used in Propulsion Drives, draws up their block diagrams and explains main features:
  - vector control
  - direct torque control
- describes remote control system of podded propulsion:

- rpm control
- steering angle control
- combined rpm and steering angle control during ship manoeuvring
- describes the harmonic distortion related to power electronic systems and use of harmonic filters

1.4.4 SAFE OPERATION AND MAINTENANCE OF HIGH-VOLTAGESYSTEMS

Required performance:

4.1 Safe Operation and Maintenance of High-Voltage Systems (12 hours)

- knows how to use HV personal protection equipment (PPE): insulated gloves, goggles, insulating bars, insulating footwear, mates, earthing cables, HV testers
- knows terms of certification of personal protection equipment
- explains HV safety procedures:
  - permission and co-ordination of HV works
  - information, warnings and protection against unauthorized influence on safety
  - assistance during HV work
  - checking for voltage presence before any work starts

STCW Section A-III-6

Operate and maintain power systems in excess of 1000V

Column 1	Column 2	Column 3	Column 4
Competence	**Knowledge, understanding and proficiency**	**Methods for demonstrating competence**	**Criteria for evaluating competence**
Operate and maintain power systems in excess of 1,000 volts	*Theoretical knowledge* High-voltage technology Safety precautions and procedures Electrical propulsion of the ships' electrical motors and control systems *Practical knowledge* Safe operation and maintenance of high-voltage systems, including knowledge of the special technical type of high-voltage systems and the danger resulting from operational voltage of more than 1,000 volts	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training, where appropriate .4 approved laboratory equipment training	Operations are planned and carried out in accordance with operating manuals, established rules and procedures to ensure safety of operations

ANNEX 2

COURSE OUTLINE

	Knowledge, understanding and proficiency	Total hours for lectures	Total hours for practical's
1.	Introduction, Safety briefing and objectives of the course.	0.25 hrs	
2.	High Voltage Technology and application on board ships, concepts and terminology.	0.75 hrs	
3.	Electrical hazards associated with High voltage systems and their precautions. eg. electrical shock, are flash and arc blast.	1.50 hrs	
4.	Arrangement of high voltage installations, switch rooms, switchboards, transformers and earthing systems.	1.50 hrs	
5.	Safety regulations regarding work on high voltage installations.	1.00 hrs	
6.	Work Permits and procedures for preventing accidents while carrying out maintenance and repairs	1.00 hrs	
7.	Operation and safety features of High Voltage switchgear and the use of HV PPE. (Practical: demonstration of PPE)	1.00 hrs	1.00 hr
8.	Regulations governing High Voltage installations in marine / offshore.	1.50 hrs	
9.	Electrical Stresses and Break down strength and ageing of High Voltage electrical insulation structure	1.00 hrs	
10.	Types of High Voltage distribution systems, their construction, insulated and non-insulated system components, cables, fuses and protective devices	1.50 hrs	
11.	Issue and control of safety documentation (Procedures, Control & policy) (Practical: Practice on actual ship's plan - Prepare switching plan, Limitation of access, Permit to work, Sanction for test & logbook)	0.75 hrs	1.00 hr
12.	Safety lockout procedures, key safes / Multi Hasp locking devices and isolation procedure (Practical: Risk Assessment and Isolation and earthing diagram)	0.75 hrs	1.00 hr
13.	Treatment of system neutral point (based on type of installation)	0.5 hrs	
14.	Electrical propulsion systems – Direct Shaft / Podded	2.00 hrs	

Knowledge, understanding and proficiency	Total hours for lectures	Total hours for practical's
type		
15. Construction and Operation of High Voltage Systems - High Voltage motors, Cyclo-converters, Frequency control and controlling of motors / propulsion drives, Transformers & other equipment (Frequency control & Bus Management Strategy and switching sequence). (Practical: Demonstration of variable frequency drive operation and show its components)	2.00 hrs	2.00 hr
16. Power Management System, instrumentation and High Voltage measuring and testing equipment. (Fixed and Portable)	2.50 hrs	
17. Polarization Index and IR Test Procedure for High Voltage equipment. (Practical: IR test on HV cable, PI and DA test demonstration).	1.50 hrs	2.50 hrs
18. Maintenance and fault Identification in High Voltage system and procedure switching and isolation procedure using appropriate tools and PPE. Draw out VCB, key safe procedure. (Practical: Demonstrate operation of VCB, Isolation, draw out, vacuum checking, gap gauging. Demonstrate vacuum contractor).	2.50 hrs	2.50 hrs
19. Emergency Procedures and Case Studies	1.00 hr	
20. Demonstration of High Voltage systems and procedure for carrying out work using appropriate tools and PPE. (Practical: At High voltage facility: Effect of shapes of electrode on voltage breakdown, surface current and creepage distance, measurement of voltage and current by CT and PT. Or Demonstrate disconnection of VCB from live bus bar, safety precautions and application of CME)	1.00 hr	3.50 hrs
Practical Assessment test & Evaluation	0.50 hrs	0.50 hr
Subtotals	**26.00 hrs**	**14.00 hrs**
Total for the course	**40.00 hrs**	

ANNEX 3

COURSE TIME-TABLE

	1st Period (2.0 Hours) (0900 - 1100hrs)	2nd Period (2.0 Hours) (1115- 1315hrs)		3rd Period (2.0 Hours) (1345- 1545hrs)	4th Period (2.0 Hours) (1600- 1800hrs)
Day 1	• Introduction, Safety briefing and objectives of the course • High Voltage Technology and application on board ships, concepts and definitions • Electrical Hazards associated with high voltage systems and earthing system. e.g. electrical shock, arc flash and arc blast and their precautions	• Electrical Hazards associated with high voltage systems and earthing system. e.g. electrical shock, arc flash and arc blast and their precautions (contd…) • Arrangement of high voltage installation, switch room, switch boards, transformers and earthing system.	LUNCH BREAK	• Safety Regulations regarding work on high voltage installations. • Work Permits and procedures for preventing accidents while carrying out maintenance and repair	• Operational and safety features associated with high voltage switchgear • Practical demonstration of PPE Types of PPE requirement for High voltage system and Donning of PPE
Day 2	• Regulations governing High Voltage installations in marine / offshore. • Electrical Stresses and Break down strength and ageing of High Voltage electrical insulation structure	• Electrical Stresses and Break down strength and ageing of High Voltage electrical insulation structure (contd) • Types of High Voltage distribution systems, their construction, insulated and non-insulated system components, cables, fuses and protective devices		• Issue and control of safety documentation (Procedures, Control & policy) • Practical: Practice on actual ship's drawing - Prepare switching plan, Limitation of Access, Permit to work, Sanction for test and logbook. • Safety lockout procedures, key safes / Multi Hasp locking devices and isolation procedure	• Safety lockout procedures, key safes / Multi Hasp locking devices and isolation procedure (contd) • Practical: Risk assessment and isolation and earthing diagram. • Treatment of system neutral point (based on type of installation)
Day 3	• Electrical propulsion systems – Direct Shaft / Podded type	• Construction and Operation of High Voltage Systems - High Voltage motors, Cyclo-converters, Frequency control and controlling of motors / propulsion drives, Transformers & other equipment (Frequency control & Bus Management Strategy) and switching sequence.		• Practical: Demonstration of variable frequency drive operation and show its components	• Power Management System, instrumentation and High Voltage measuring and testing equipments. (Fixed and Portable)
Day 4	• Power Management System, instrumentation and High Voltage measuring and testing equipments. (Fixed and Portable) (contd..) • Polarization Index and IR Test Procedure for High Voltage equipments.	• Practical: IR test on HV cable, PI and DA test demonstration.		• Practical: IR test on HV cable, PI and DA test demonstration. (contd) • Maintenance and fault Identification in High Voltage system and procedure using appropriate tools and PPE. Draw out procedure of VCB and Key safe procedure.	• Maintenance and fault Identification in High Voltage system and procedure using appropriate tools and PPE. Draw out procedure of VCB and Key safe procedure. . (contd…) • Practical: Demonstrate operation of VCB, Isolation, draw out, vacuum checking, gap gauging. Demonstrate vacuum contactor.

	1st Period (2.0 Hours) **(0900 - 1100hrs)**	2nd Period (2.0 Hours) **(1115- 1315hrs)**		3rd Period (2.0 Hours) **(1345- 1545hrs)**	4th Period (2.0 Hours) **(1600- 1800hrs)**
Day 5	• Practical: Demonstrate operation of VCB, Isolation, draw out, vacuum checking, gap gauging. Demonstrate vacuum contactor. (contd) • Emergency Procedures and Case Studies	• Emergency Procedures and Case Studies (contd) • Demonstration of High Voltage systems and procedure for carrying out work using appropriate tools and PPE	LUNCH BREAK	• Practical: • At High voltage facility – Effect of shape of electrode on voltage breakdown, surface current and creep-age distance, measurement of voltage and current by CT and PT. OR Demonstrate disconnection of VCB from live bus bar, safety precautions and application of CME	• Practical: (contd…) • At High voltage facility – Effect of shape of electrode on voltage breakdown, surface current and creep-age distance, measurement of voltage and current by CT and PT. OR Demonstrate disconnection of VCB from live bus bar, safety precautions and application of CME • Practical Assessment test & Evaluation.

ANNEX 4

Institute's LOGO

NAME and ADDRESS of the D. G. Approved Training Institute

INDOS No: Tel: Fax: E-mail:

Certificate No: _____

THIS IS TO CERTIFY THAT *[full name of candidate]*

Date of Birth ..... (dd/mm/yyyy)

Holder of C.D.C. No. .....

Certificate of Competency (if any), Grade : ..... No. .....

Indian National Database of Seafarers (INDoS No.) .....

has successfully completed a training course in

HIGH VOLTAGE SAFETY AND SWITCH GEAR

(MANAGEMENT LEVEL)

held from ..... to .....

This course is approved by the Directorate General of Shipping and meets the requirements laid down in Regulation III/2 paragraph 2, Section A-III/2 and relevant sections of Table A-III/2; and Regulation III/6 paragraph 2, Section A-III/6 and relevant sections of Table A-III/6 of the STCW Convention and Code 1978, as amended in 2010.

The candidate has also met the additional criteria in the STCW convention, applicable to the issue of the certificate.

This certificate is issued under the authority of the Directorate General of Shipping, Ministry of Shipping, Government of India.

_____
Signature of Candidate

_____
Name and Signature of Course In-charge

Date of Issue: _____

Date of Expiry: UNLIMITED

_____
Name and Signature of Dean / Principal

Official seal

Colour Photograph (35 mm x 35 m m)

(Details of topics covered are mentioned overleaf)

The participants have received theoretical and practical training on the following systems and equipment:

- High Voltage Technology and its applications on board ships
- Marine / offshore statutory electrical high voltage regulations
- Electrical hazards associated with High Voltage systems and their precautions
- Arrangement of high voltage installations
- Work Permits and procedures for carrying out maintenance and repairs. Use of PPE.
- Types of High Voltage systems their construction and protection devices
- Issue and control of safety documentation including Procedures, Control & policy
- Treatment of system neutral point and grounding system
- Electrical Propulsion systems – direct shaft and podded type
- HV system motor, transformers, cyclo-converters, Frequency control & Bus Management Strategy
- Power management system, instrumentation and measuring equipment
- Cable Trunking Procedure and duct protections
- Fault identification in High voltage system and switching and isolation procedure
- Practical exercises
- Case studies