ФЕДЕРАЛЬНОЕ АГЕНТСТВО ПО РЫБОЛОВСТВУ

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АНГЛИЙСКИЙ ЯЗЫК ДЛЯ СУДОВЫХ ЭЛЕКТРОМЕХАНИКОВ: ЭЛЕКТРИЧЕСКАЯ РАСПРЕДЕЛИТЕЛЬНАЯ СИСТЕМА

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ENGLISH FOR ELECTRICAL ENGINEERS: ELECTRICAL DISTRIBUTION SYSTEM

Учебное пособие
для студентов и курсантов
старших курсов
судомеханических факультетов
морских вузов

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Настоящее учебное пособие содержит тематические тексты, базовый словарь, упражнения на все виды речевой деятельности (reading, writing, speaking, listening), развитие лексических и грамматических навыков.

Пособие предназначено для обучения профессиональному морскому английскому языку студентов и курсантов старших курсов судомеханических факультетов морских высших учебных заведений, а также для судовых электромехаников.

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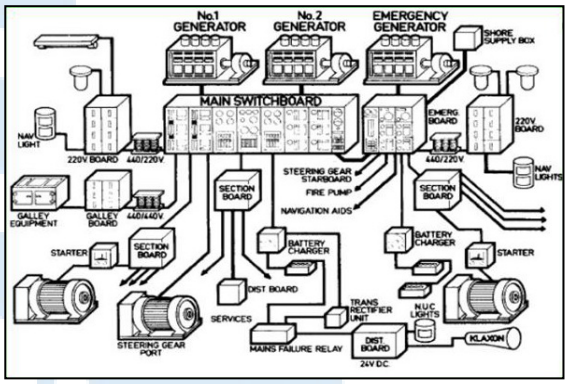
UNIT 1. POWER DISTRIBUTION SYSTEM

Lead-in

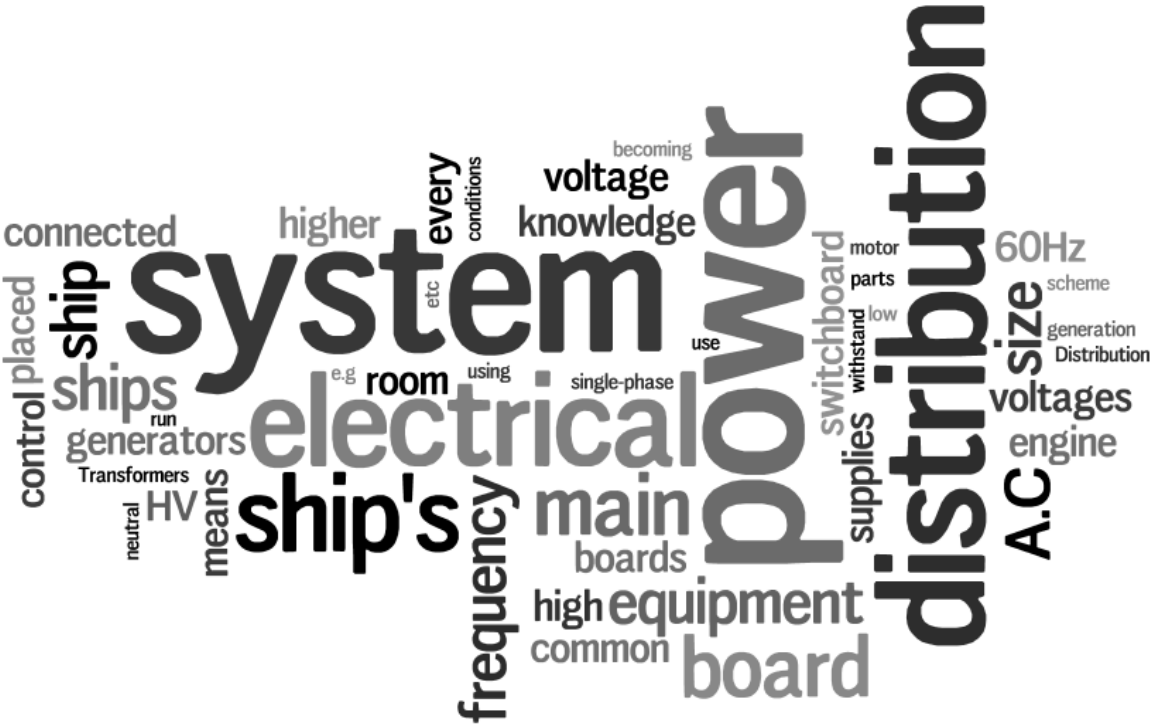
Describe what you can see in each photograph.



Vocabulary

main switchboard item equipment connect convey fuse
electrical power distribution system emergency generator supply
circuit breaker transformer faulty circuit scheme layout
withstand humidity encounter wire load frequency device
Alternating Current (A.C.) Direct Current (D.C.) High/Low voltage (HV/LV)

Pre-reading vocabulary



Reading

Power Distribution System

The function of a ship's electrical distribution system is to safely convey electrical power to every item of equipment connected to it.

The most obvious element in the system is the main switchboard. The main board supplies bulk power to motor starter groups (often part of the main board), section boards and distribution boards. Transformers interconnect the HV and LV distribution sections of the system. Circuit breakers and fuses strategically placed throughout the system automatically disconnect a faulty circuit within the network.

The main switchboard is placed in the engine control room and from there engine room staff monitor and control the generation and distribution of electrical power. It is very important that every engineer has a profound knowledge of the electrical distribution of the ship's power. The only way to acquire this knowledge is to study the ship's power diagrams.

Almost all oceangoing ships have an A.C. distribution system in preference to a direct current D.C. system. Usually a ship's electrical distribution scheme follows shore practice. This allows normal industrial equipment to be used after being adapted and certified where and if necessary, so it can withstand the conditions on board of a ship (e.g. vibration, freezing and tropical temperatures, humidity, the salty atmosphere, etc. encountered in various parts of the ship).

Most ships have a 3-phase A.C., 3-wire, 440 V insulated-neutral system. This means that the neutral point of star connected-generators is not earthed to the ship's hull. Ships with very large electrical loads have generators operating at high voltages (HV) of 3.3 KV, 6.6 KV, and even 11 KV. By using these high voltages we can reduce the size of cables and equipment. High voltage systems are becoming more common as ship size and complexity increase. The frequency of an A.C. power system can be 50 Hz or 60 Hz. The most common power frequency adopted for use on board ships is 60 Hz. This higher frequency means that generators and motors run at higher speeds with a consequent reduction in size for a given power rating. Lighting and low power single-phase supplies usually operate at 220 V. This voltage is derived from a step down transformer connected to the 440 V system.

Figure shows an HV/LV layout of a ship's distribution system. The system is called radial, or branching, and it has a simple and logical structure.

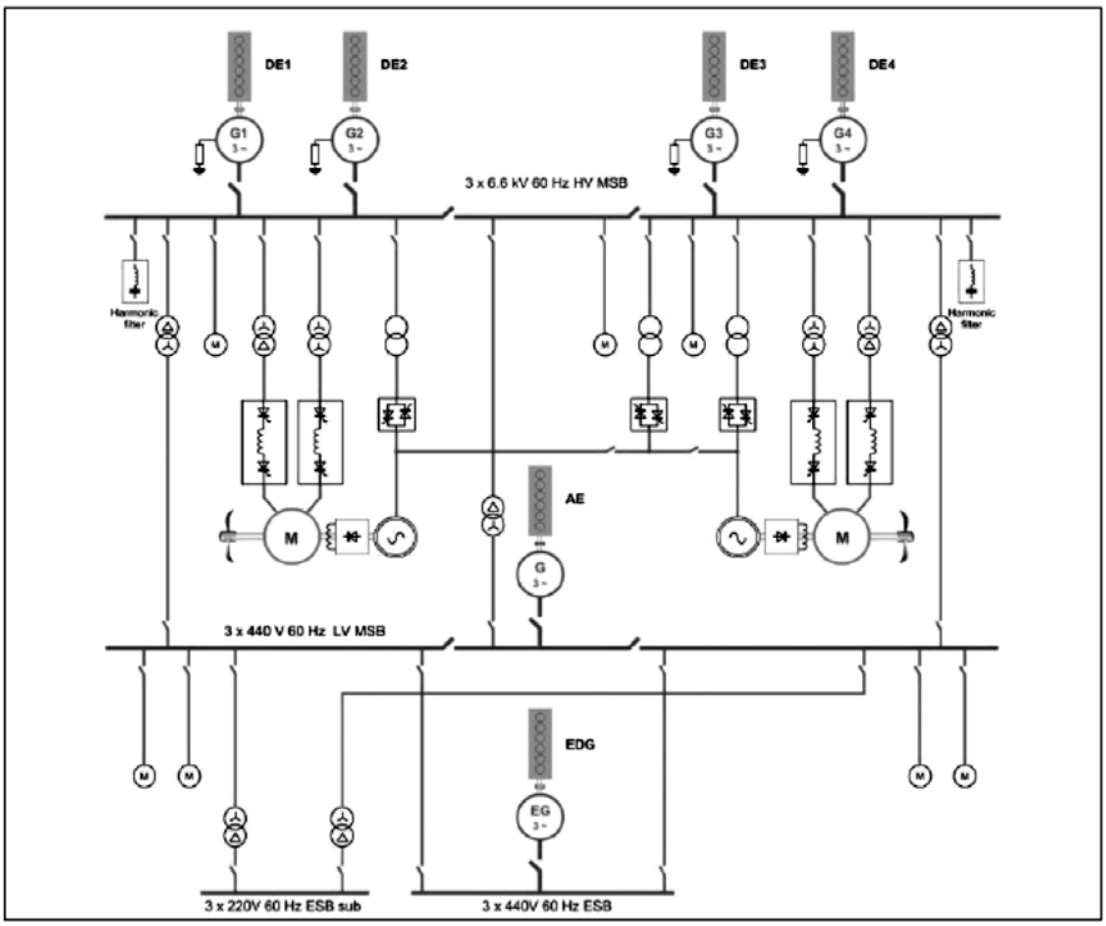


Figure. HV/LV power system

Exercises

Ex. 1. Find the word or the phrase in the text:

Система распределения мощности, электрическая распределительная система, передавать электрическую энергию, оборудование, соединять, очевидный элемент, главный распределительный щит, снабжать, основная мощность, трансформатор, высокое напряжение, низкое напряжение, автоматический выключатель, предохранитель, разъединять, неисправность цепи, контролировать, генерирование, глубокое знание, получать знания, постоянный ток, переменный ток, схема, следовать береговой практике, позволять, адаптированный, сертифицированный, условия на борту, влажность, различные части корабля, трехфазный, изолированная нейтраль, генератор, заземлен к корпусу судна, электрическая нагрузка, уменьшать размер кабеля, увеличение размера и сложности судна, частота, использование на борту судна, последовательное сокращение, номинальная мощность, освещение, полученный из, раскладка.

Ex. 2. Answer these questions:

1. What is the function of a ship's electrical distribution system?
2. What is the most obvious element in the system?
3. What does the main switchboard do?
4. What are the functions of transformers, circuit breakers and fuses?
5. Where is the main switchboard placed?
6. How can engineers acquire the knowledge of the electrical distribution?
7. What kind of distribution system do almost all oceangoing ships have?
8. Why does a ship's electrical distribution scheme follow shore practice?
9. What does 3-phase A.C., 3-wire, 440 V insulated-neutral system mean?
10. Why do ships with very large electrical loads have generators operating at high voltage?
11. What is the most common power frequency adopted for use on board?
12. What voltages do lighting and low power single-phase supplies need?

Ex. 3. Are the sentences true or false?

1. The most obvious element in the ship's electrical distribution system is a circuit breaker.
2. The main switchboard automatically disconnects a faulty circuit within the network.
3. Transformers interconnect the HV and LV distribution sections of the system.
4. The main switchboard is placed at the navigating bridge.
5. Almost all oceangoing ships have D.C. distribution system.
6. Usually a ship's electrical distribution scheme follows shore practice.
7. Most ships have a 3-phase A.C., 3-wire, 440 V insulated-neutral system.
8. Low voltage systems are becoming more common as ship size and complexity increase.
9. The most common power frequency adopted for use on board ships is 50 Hz.
10. Lighting and low power single-phase supplies operate at 440 V.

Ex. 4. Translate the sentences:

1. Функцией электрической распределительной системы судна является безопасная передача электроэнергии к каждому элементу оборудования, подключенного к нему.
2. Главный распределительный щит размещен в машинном отделении, и персонал контролирует генерацию и распределение электроэнергии.
3. Очень важно, чтобы каждый инженер имел глубокое знание системы распределения электроэнергии на судне.
4. Частота системы питания переменного тока может быть 50 или 60 Гц.
5. Система называется радиальной и имеет простую и логическую структуру.

Writing

Ex. 5. Write the short summary of the text (10-15 sentences).

Follow the plan:
1. The function of a ship's electrical distribution system.
2. The main switchboard.
3. The distribution system of oceangoing ships.
4. 220 V and 440 V systems on board.

Speaking

Ex. 6. Speak on the topic «Power Distribution System»

Listening

Ex. 7. Listen to the text and fill the gaps.

This is program 2 of Videotel series on practical marine electrical knowledge. The series is made up of 8 programs. Program 2 deals with the _____ _____ _____ on board ship including its 3 main faults: _____ fault, _____ _____ fault, _____ _____ fault and the remedies.

There are many system variations around so it’s most important that you become familiar with the _____ of electrical system and the _____

of the main switchboard immediately you join the ship. Pay particular attention to the layout of the _____ _____ . This study will pay dividends during the blackout or when troubleshooting cause of the major breakdown.

Now we must emphasize electrical safety. The _____ _____ is “before any work is done on the electrical _____ first isolate the circuit by removing the supply _____ or locking the circuit _____ in the open position so that the circuit cannot be energized accidently”. Then post a warning sign to alert the others the circuit is being worked on. Then prove the circuit dead with the _____ or an approved line tester. The switchboard can never be considered dead unless all AC generators connected to it are stopped, locked off and all other suppliers are _____ . These points can never be emphasized strongly enough. The electrical rescue procedure is described in program 1 of the series.

Ex. 8. Watch the video and answer the questions:

1. What is program 2 about?
2. What is the golden rule of the electrical safety?
3. What is described in program 1 of the series?

Grammar: Present Simple and Present Continuous

A. Complete the sentences. Use Present Simple or Present Continuous.

1. He always … to lock the door. (forget)
2. Those stevedores … quickly enough! (not work)
3. … you … for a new job? (look)
4. Why … he … the leak? (not mend)
5. That barrel … oil! (contain)
6. … you … remember my telephone number? (remember)
7. I …a First Aid course at the moment. (do)
8. Why … he … to New York so often? (go)
9. He … that story. (not believe)
10. The 2nd Officer … a good sense of humor. (have)
11. Wait a minute! I … a shower. (have)
12. He is so untidy! He always … his clothes and books lying all over the cabin. (leave)
13. I always … for identification when a visitor boards. (ask)
14. We … fire alarm every week. (check)
15. They … the fire hoses now. (inspect)
16. I … technical terms for my job once a week. (record)
17. I always … new phrases from the SMCP. (store)

B. Put these words in the correct order to make sentences. Put them in negative and question forms.

1. we / overhaul / plan / to / engine / the / main.
2. bad / connection / the / very / is.
3. the / check / requires / a / blower / careful.
4. high / motor / revolutions / operating / at / the / is.
5. are / bearing / the new one / replacing / the / damaged / we / with.

C. Circle the odd one out. Write a sentence with the circled word. Use Present Simple or Present Continuous.

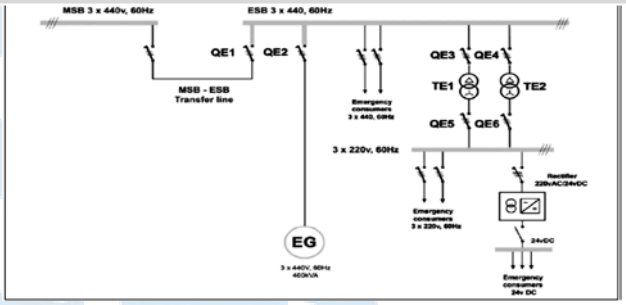
1. Get, receive, obtain, send.
2. Emergency, disaster, safety, accident.
3. Correction, mistake, fault, error.
4. Hull, mast, deck, dock.
5. Messroom, engine room, galley, cold store.

UNIT 2. EMERGENCY POWER SUPPLY

Lead-in

Describe what you can see in each photograph.

Emergency power supplies



Vocabulary

emergency power supply battery hydraulic accumulator source install provide maintain failure diesel-driven hand-driven watertight door evacuation require self-contained occur internal combustion engine hand cranked blackout permit

Pre-reading vocabulary

Reading

Emergency Power Supply

An emergency electrical power service must be provided in the event of a main power failure. This is for emergency lighting, alarms, communications, watertight doors and other services necessary to maintain safety and permit safe evacuation of the ship.

Regulations require that the emergency power source is a generator, batteries or both. The emergency power source must be self-contained and not dependent upon any other engine room power supply. A battery, when fully charged, is self- contained. An emergency generator must have an internal combustion engine as prime mover and have its own fuel supply tank, starting equipment and switchboard in the near vicinity.

The emergency supply should automatically operate as quickly as possible but not later than 45 seconds after the failure of the main source of power. Emergency batteries should be arranged so that they are switched into service immediately following a main power failure. Emergency generators can be hand cranked, but are usually automatically started by compressed air or a battery to ensure immediate run-up following a main power failure. Other cranking options should be provided to ensure safety, e.g. cranking by means of the electric starter driven with a set of batteries or with a hydraulically driven starter accompanied by a hand-driven pump and hydraulic accumulator.

Although regulations may permit a battery to be the sole source of emergency power, in practice a suitable battery may be physically very large and so a diesel-driven generator is usually installed, with its own starting battery large enough to sustain several consequent starting attempts or to air start (hydraulic start) supply.

Another set of batteries should also be installed locally to supply automation, the alarm system, navigation aids and the ship's communication equipment (such as GMDSS).

On passenger ships, SOLAS Chapter 11-1, Part D, requires that the primary emergency power supply is provided by a diesel-driven generator for up to 36 hours (18 hours for non-passenger vessels). In addition, an emergency transitional battery must also be installed to maintain vital services (mainly lighting) for a short period - typically a minimum of 3 hours. This emergency battery is to ensure that a total blackout cannot occur in the transitional period between loss of main power and the connection of the emergency generator.

The emergency power system must be ready and available at all times and this level of reliability requires special care and maintenance. The system must be tested at regular intervals to confirm that it does operate correctly. The testing is normally carried out during the weekly emergency fire and boat drill practice sessions.

Exercises

Ex. 1. Find the word or the phrase in the text:

Аварийное электроснабжение, должно быть обеспечено, сбой электропитания, аварийное освещение, водонепроницаемая дверь, осуществлять безопасную эвакуацию, источник аварийного электропитания, автономный, зависеть от, полностью заряжен, двигатель внутреннего сгорания, топливный бак, оборудование, в непосредственной близости, переключать, с ручным рычагом, незамедлительное включение, обеспечить безопасность, гидроаккумулятор, единственный источник, подходящий, с дизельным приводом, устанавливать, достаточно большой, выдерживать, попытка, аварийная сигнализация, средства навигации, жизненно важное оборудование, полное отключение электричества, случаться, потеря основного источника питания, соединение, должен быть готов и доступен, уровень надежности, ремонт и обслуживание.

Ex. 2. Answer these questions:

1. When do we need an emergency electrical power service?
2. What is an emergency power source according to regulations?
3. Describe the requirements for the emergency power source.
4. When should the emergency supply start to operate automatically?
5. Can emergency generators be hand cranked?
6. Why do we need cranking options?
7. Is it possible to have a battery as the sole source of emergency power?
8. How many hours of emergency power supply should the diesel-driven generator provide on passenger and non-passenger vessels according to SOLAS?
9. Why is there a need of an emergency transitional battery?
10. When is the testing of the emergency power system carried out?

Ex.3. Are the sentences true or false?

1. An emergency electrical power service must be provided during a dry docking period.
2. The emergency power source must be self-contained and not dependent upon any other engine room power supply.
3. Emergency generators must be hand cranked.
4. A diesel-driven generator is usually installed with its own starting battery large enough to sustain several consequent starting attempts.
5. The primary emergency power supply is provided by a diesel-driven generator for up to 3 hours.
6. The emergency battery is to ensure that a total blackout cannot occur in the period between a momentary loss of concentration and electric shock.
7. The emergency power system doesn't require special care and maintenance.

Ex.4. Translate the sentences:

1. Аварийное электроснабжение должно быть обеспечено для организации безопасной эвакуации с морского судна.
2. Правила требуют, чтобы аварийным источником питания являлись генератор, батареи или то и другое.
3. Аварийный источник питания должен сработать автоматически, не позднее, чем через 45 секунд после выхода из строя основного источника питания.
4. Набор батарей должен быть установлен для электроснабжения автоматики, систем аварийной сигнализации, навигационных средств и оборудования связи судна.
5. Система аварийного электроснабжения должна тестироваться регулярно во время противопожарных учений.

Writing

Ex. 5. Write the short summary of the text (10-15 sentences).

Speaking

Ex. 6. Speak on the topic "Emergency power supply".

Listening

Ex. 7. Listen to the text and fill the gaps.

1. This is a typical radio AC distribution system. Its basic function is _____.
2. Protection is provided by _____.
3. Each circuit breaker or fuse in the system is designed to _____.
4. Whatever the design layout of your main switchboard may be, you will have _____.
5. Then there are _____.
6. Many configurations are in use and in most cases the controls for synchronizing alternators will be found on these panels such as _____.
7. In addition there will be _____.
8. The output of the electrical system is then monitored by _____.
9. The health of the distribution system insulation is monitored by _____.
10. The emergency switchboard is a _____.
11. The metering system inside the switchboard are fed by _____.
12. Then the terminals of the current transformer must be shorted out. If this is not done, _____.

Ex. 8. Watch the video and answer the question:

1. What is the basic function of AC distribution system?
2. What power does it provide?
3. What components can be found on the layout of the main switchboard?

Grammar: Future Simple, going to and Present Continuous

A. Complete the sentences. Use Future Simple, going to or Present Continuous.

1. You … time to look around the town. (not have)
2. I have already talked to the engineer about the problem. He … the spare parts tomorrow. (order)
3. I'd like to help, but I can't. I … with loading all day. (help)
4. Hey! Do you want to come ashore with us? We … Yokohama when we are in port tomorrow.
5. Please, lend me some money. I … you back tomorrow. (pay)
6. I … Mr Jones at 3 pm this afternoon. (meet)
7. What time … you …? (leave)
8. I … the documents. (check)
9. We … a fire drill in 2 days. (do)
10. I don't have time to go to the post office. … you … these letters for me? (post)

B. Put these words in the correct order to make sentences. Put them in negative and question forms.

1. new / they / install / are / bridge / a / computer / going to / on / the.
2. tomorrow / pieces / will / cut / pipe / he / into / two.
3. 4th / is / maintain / going to / the / all / deck / engineer / machinery.
4. plugging / they / the / scuppers / are / the / on / deck.
5. is / off / all / wiping / A.B. / dirt / internal / parts / to remove / now.
6. fuel / he / testing / for / quality / samples / is.
7. We / rust / remove / pipes / mud / will / and / from / the / in / 2 hours.

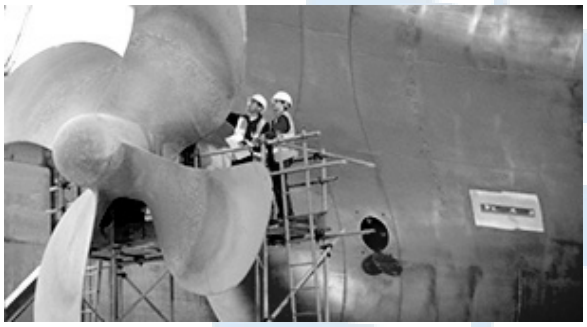
C. Circle the odd one out. Write a sentence with the circled word. Use Future Simple, going to or Present Continuous.

1. Whistle, propeller, alarm, bell.
2. Coastguard, surveyor, lighthouse, pilot.
3. Voyage, journey, trip, entry.
4. Clean, destroy, polish, tidy.
5. Cut, divide, slice, join.
6. Record, register, buy, log.
7. Send, Haul, tow, drag.

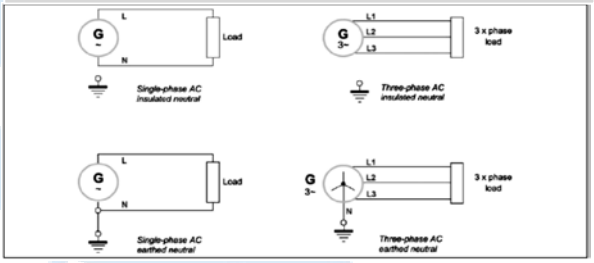
UNIT 3. INSULATED AND EARTHED NEUTRAL SYSTEM

Lead-in

Describe what you can see in each photograph.



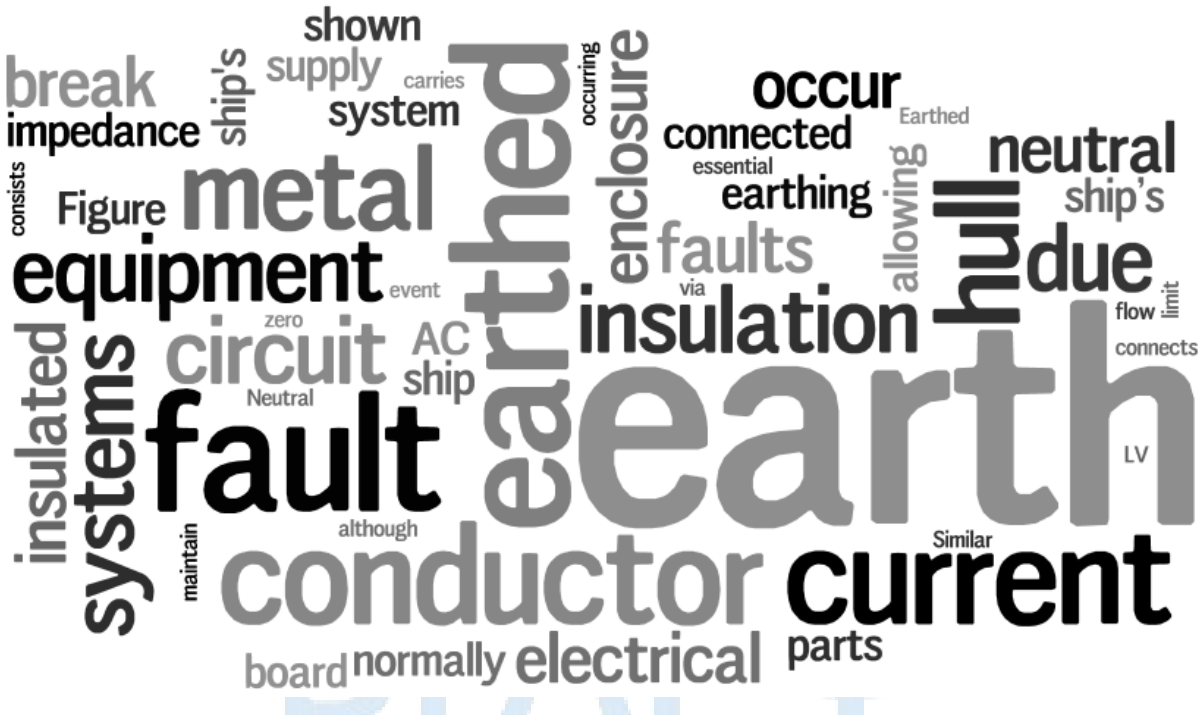
Insulated and earthed neutral systems



Vocabulary

earth conductor insulated neutral point fault current
circuit hull substitute ashore ground resistor impedance
priority requirement essential event flow allow
insulation electric shock prevent bonding similar loose

Pre-reading vocabulary



Reading

Insulated and Earthed Neutral Systems

An insulated system is one that is totally electrically insulated from earth. By absence of the earth on board of a ship, the ship's hull can be used as a substitute for the earth.

An earthed system has the supply neutral point connected to earth.

Shipboard main LV systems at 380 V AC and 440 V AC are normally insulated from earth (ship's hull), although earthed neutral systems can also be encountered. Similar systems ashore are normally earthed to the ground. HV systems (>/=1000 V) are usually earthed to the ship's hull via a neutral earthing resistor (NER) or through a high impedance transformer to limit earth fault current.

The priority requirement on board ship is to maintain continuity of the electrical supply to essential equipment in the event of a single earth fault occurring.

A circuit consists of two parts shown in Figure (a):

– conductor, which carries current through the circuit;
– insulation, which keeps the current inside the conductor.

Three basic circuit faults that can occur are shown in Figure (b):

– an open-circuit fault is due to a break in the conductor, as at A. so that current cannot flow;
– an earth fault is due to a break in the insulation, as at B, allowing the conductor to touch the hull or an earthed metal enclosure;
– a short-circuit fault is due to a double break in the insulation, as at C, allowing both conductors to be connected so that a very large current by-passes, or short-circuits, the load.

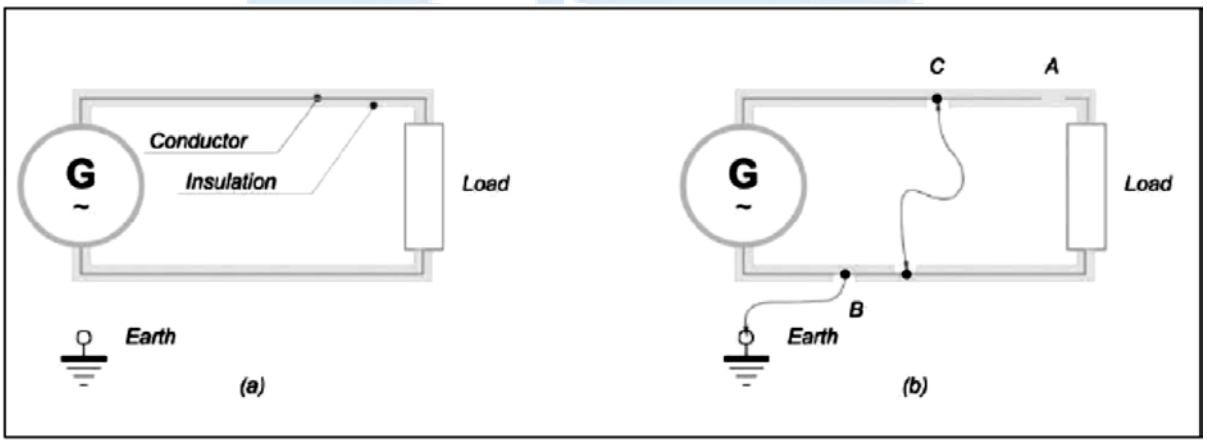


Figure. Circuit faults

The size of fault current that will occur depends on the overall impedance left in the circuit under fault conditions.

The majority of earth faults occur within electrical equipment due to an insulation failure or a loose wire, which allows a live conductor to come into contact with its earthed metal enclosure.

To protect against the dangers of electric shock and fire that may result from earth faults, the metal enclosures and other non-current carrying metal parts of electrical equipment must be earthed. The earthing conductor connects the metal enclosure to earth (the ship's hull) to prevent it from attaining a dangerous voltage with respect to earth. Such earth bonding of equipment ensures that it always remains at zero volts.

Exercises

Ex. 1. Find the word or the phrase in the text:

Изолированный, заземленная нейтраль, отсутствие, корпус судна, заменитель, нулевая точка, соединять, низковольтная система, похожий, на берегу, резистор цепи заземления нейтрали, сопротивление, трансформатор высокого сопротивления, ограничивать, ток замыкания на землю, приоритетное требование, обеспечивать непрерывность, электроснабжение, необходимое оборудование, в случае, случаться, цепь, проводник, изолятор, неисправность цепи, обрыв электрической цепи, течь, замыкание на землю, короткое замыкание, нагрузка, повреждение изоляции, слабое соединение проводов, позволять, заземленный металлический корпус, защищать, опасность, поражение электрическим током, предотвратить, получать, соединение, оставаться.

Ex. 2. Answer these questions:

1. What is the insulated system?
2. What can be used as a substitute for the earth on board of a ship?
3. What is the earthed neutral system?
4. What equipment can be used to earth HV systems to the ship’s hull?
5. What is the priority requirement on board ship?
6. How many parts does the circuit have?
7. Describe three basic circuit faults.
8. What influences the size of fault current?

9. What are the main reasons of the majority of earth faults?
10. What should be done to protect against the dangers of electric shock and fire that may result from earth faults?

Ex. 3. Are the sentences true or false?

1. There are two basic circuit faults.
2. The priority requirement on board ship is to maintain continuity of the electrical supply to essential equipment in the event of a single earth fault occurring.
3. A circuit consists of a conductor, insulation and the ship's hull.
4. An earth fault is due to a double break in the insulation allowing the conductor to touch the hull or an earthed metal enclosure.
5. The majority of earth faults occur within electrical equipment due to conductor, which carries current through the circuit.
6. To protect against the dangers of electric shock and fire that may result from earth faults, the metal parts of electrical equipment must be earthed.

Ex. 4. Translate the sentences:

1. Электрическая цепь состоит из двух частей: проводника и изолятора.
2. Изолированной системой является та, которая электрически полностью изолирована от земли.
3. Заземленная система имеет нулевую точку (нейтраль), соединенную с землей.
4. Высоковольтные системы заземлены к корпусу судна с помощью резистора цепи заземления нейтрали или трансформатора высокого сопротивления.
5. Обрыв электрической цепи происходит из-за поломки в проводнике так, что ток не может течь.
6. Большинство замыканий на землю происходят внутри электрооборудования из-за повреждения изоляции или слабого соединения проводов.

Writing

Ex. 5. Write the short summary of the text (10-15 sentences).

Speaking

Ex. 6. Speak on the topic «Insulated and Earthed Neutral Systems».

Listening

Ex. 7. Listen to the text and fill the gaps.

1. The insulation _____ of the entire system is monitored by an earth meter and earth fault lamps.
2. When a fault appears the _____ _____ and _____ _____ are switched off one by one until the fault indication disappears on the board.
3. And the _____ is posted on the isolator switch that the circuit is being worked on.
4. First check the meter for the correct _____, then check for 2 good earths, then all 3 phases should be checked even if the phase _____ in the motor are electrically connected.
5. Having found the earth fault on all 3 cable ends, the _____ _____ must now be disconnected from the motor so they can be tested separately.
6. A _____ of the connection of the feeder cables and the terminal box prior to disconnection will _____ correct reconnection after the investigation.
7. This shows normal condition, no earth fault _____ there.
8. A _____ in the insulation has caused the _____ to touch the casing of the terminal box.
9. The fault is quickly _____ by cutting the cable where the insulation is damaged and stripping back the wire for the straight connection to be fitted on both ends.
10. Alternatively if the cable is _____ enough cut off the damaged section and reconnect the cable to the terminal.
11. Having completed the repair check the joint for the _____.

Ex. 8. Watch the video and answer the question:

1. What equipment monitors the insulation resistance of the entire system?
2. What equipment is used to check the circuit?
3. Describe the procedure for investigation an earth fault.

Grammar: Present Perfect and Past Simple

A. Circle the most appropriate tense, Present Perfect or Past Simple.

1. *The rain has stopped / The rain stopped* half an hour ago but the crew hasn't started / the crew didn't start loading yet.
2. *Have you seen / Did you see* the whales when you have been / you were on watch?
3. *Have you met / Did you meet* the superintendent before?
4. Why do you feel you could do this job? – Well, *I have done / I did* similar jobs before.
5. *He has hurt / He hurt* his back last month, so I heard. – Yes, he has fallen / fell off a ladder.
6. *Have you already checked / Did you check* the fire fighting equipment?
7. *They still haven't sent / They didn't send* us details of the training course.
8. *He hasn't checked / He didn't check* the davits yet.
9. *I have just seen / I saw* him in the messroom.
11. The crew didn't receive the wages *they have expected / they expected* from the shipping company three months ago

B. Put these words in the correct order to make sentences. Put them in negative and question forms.

1. removed / valve / have / they / just / that / faulty / fuel.
2. refilled / cylinder / that / tank / and / we / measured / the / pressure.
3. the / mechanism / engineer / has / 3rd / lubricated / all / parts / moving / of / already.
4. yet / our / these / for / electrician / hasn't / cables / faults / checked.
5. Bosun / grinder / before / the surface / with / the / grinded / painting.

C. Circle the odd one out. Write a sentence with the circled word. Use Present Perfect or Past Simple.

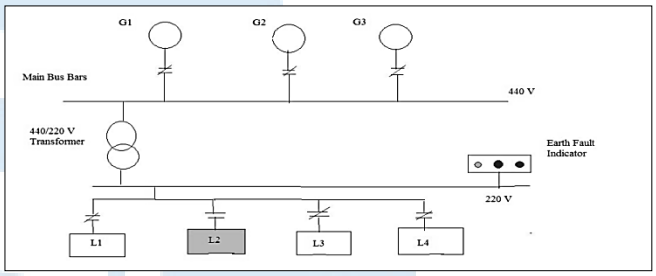
1. Distress, joy, grief, upset.
2. Wound, bondage, sprain, bruise.
3. Salary, wage, job, payment.
4. Help, prohibit, deny, ban.
5. Expect, anticipate, hope, fail.

UNIT 4. SIGNIFICANCE OF EARTH FAULTS

Lead-in

Describe what you can see in each photograph.

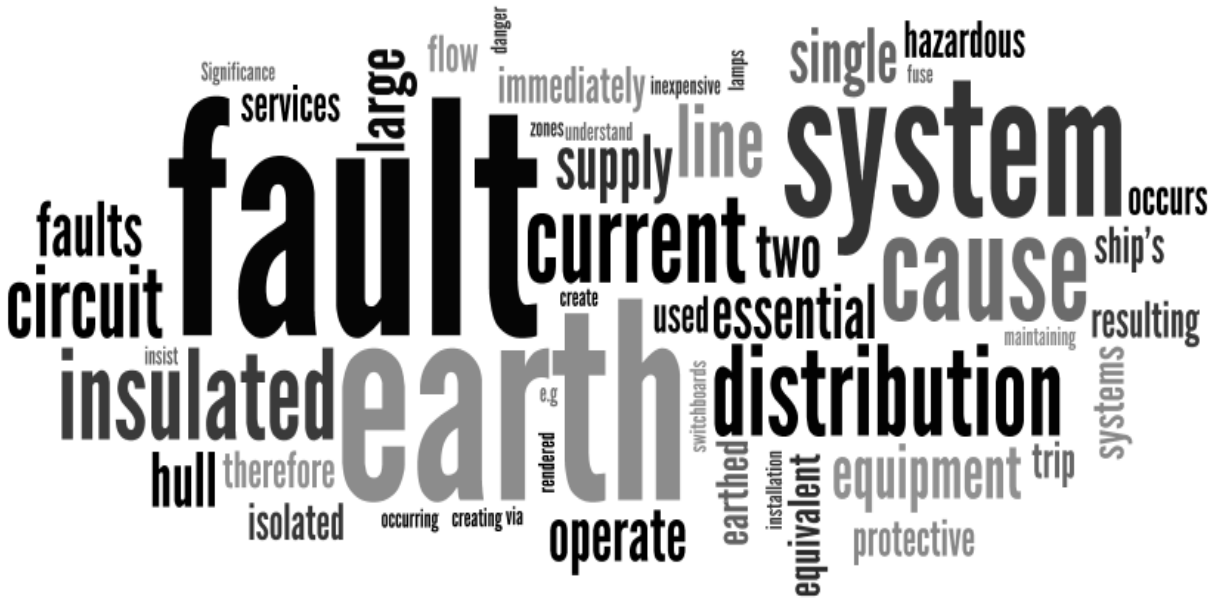
Earth fault indication



Vocabulary

significance earth fault short-circuit fault through immediately
cause hazardous protective render loss of power
trip arcing intend continuity circulate fit steering gear
insist reduce flammable installation provide

Pre-reading vocabulary



Reading

Significance of earth faults

If a single earth fault occurs on the live line of an earthed distribution system it would be the equivalent to a short-circuit fault across the generator through the ship's hull. The resulting large current would immediately cause the line protective device (fuse or circuit breaker) to trip out the faulty circuit. The faulted electric equipment would be immediately isolated from the supply and so rendered safe. However, the loss of power supply could create a hazardous situation, particularly if the equipment was classed essential, e.g. steering gear. The large fault current could also cause arcing damage at the fault location.

By contrast a single earth fault “A” occurring on one line of an insulated distribution system will not cause any protective trip to operate and the system would continue to function normally as shown in Figure.

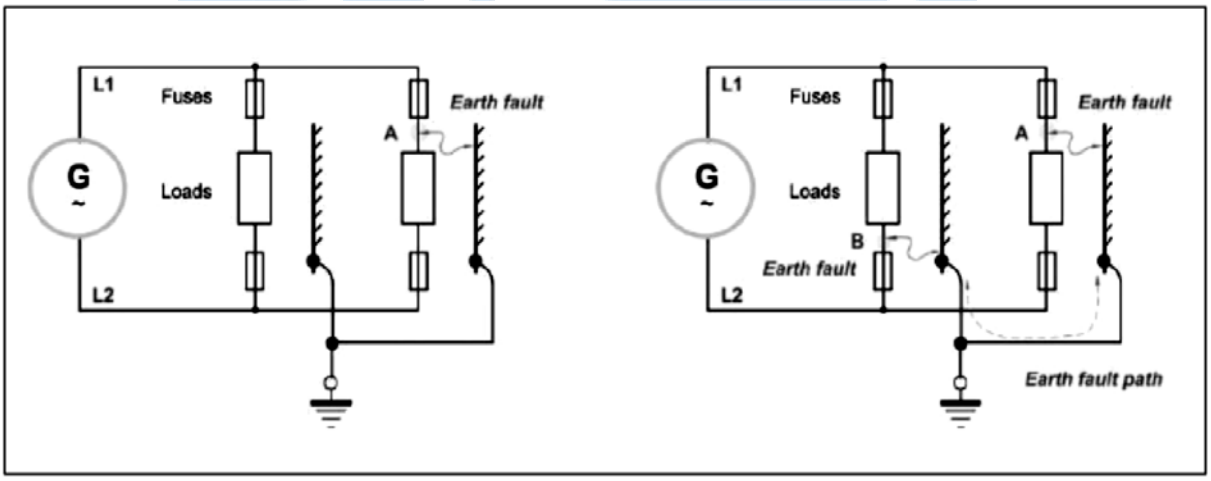


Figure. Double earth faults in an insulated systems

This is the important point: equipment continues to operate with a single earth fault as it does not provide a closed circuit so no earth fault current will flow.

If a second earth fault at “B” occurs on another line of the insulated system, the two faults together would be equivalent to a short- circuit fault (via the ship's hull) and the resulting large current would operate protection devices and cause disconnection of perhaps essential services creating a risk to the safety of the ship.

An insulated distribution system therefore requires two earth faults on two different lines to cause an earth fault current to flow.

An insulated system is, therefore more effective than an earthed system in maintaining continuity of supply to essential services, which is why it is used for most marine electrical systems.

Regulations insist that tankers have only insulated distribution systems. This is intended to reduce danger from earth fault currents circulating in the hull within hazardous zones, which may cause an explosion of the flammable cargo.

An earth fault monitor should be fitted to the main and emergency switchboards to indicate the presence of an earth fault on each isolated section of a distribution system.

Earth indication lamps have been the most common method used for many years and are an inexpensive installation that is easy to understand.

Exercises

Ex. 1. Find the word or the phrase in the text:

Значимость, замыкание на землю, случаться, короткое замыкание, корпус судна, ток, немедленно, защитное устройство, предохранитель, автоматический выключатель, отключать, неисправная цепь, оборудование, изолировать, источник питания, обезопасить, потеря мощности, создавать опасную ситуацию, существенный, рулевой механизм, искрение/горение, место повреждения, изолированная распределительная система, продолжать функционировать, обеспечивать, течь (ток), отключение, следовательно, требовать, поддерживание непрерывности питания, правила/требования, предназначаться, уменьшать опасность, циркулировать, взрыв, легковоспламеняющийся груз, монитор, должен быть установлен, показывать, наличие, индикаторная лампа, общераспространенный метод, недорогая установка.

Ex. 2. Answer these questions:

1. What is the equivalent of a single earth fault on the live line of an earthed distribution system?
2. What process would a single earth fault cause?
3. What could cause the large fault current?
4. Does the equipment continue to operate with a single earth fault?
5. Does the equipment continue to operate with the two faults together?

6. What distribution system is used for most marine electrical systems? Why?
7. What distribution system should tankers have according to regulations? Why?
8. What should be fitted to the main and emergency switchboards to indicate the presence of an earth fault?
9. What is the most common method used for the earth fault indication?

Ex.3. Are the sentences true or false?

1. A single earth fault occurring on one line of an insulated distribution system causes the line protective device (fuse or circuit breaker) to trip out the faulty circuit.
2. The large fault current could cause arcing damage at the fault location.
3. An earthed distribution system requires two earth faults on two different lines to cause an earth fault current to flow.
4. An insulated system is less effective than an earthed system.
5. An insulated distribution system is intended to reduce danger from earth fault currents circulating in the hull within hazardous zones.
7. Earth indication lamps are an expensive installation that is difficult to understand.

Ex.4. Translate the sentences:

1. Потеря электропитания может создать опасную ситуацию для оборудования судна.
2. Ток короткого замыкания может вызвать искрение в месте повреждения.
3. Следовательно, оборудование продолжает работать с одним замыканием на землю, и система функционирует нормально.
4. Изолированная распределительная система используется для большинства морских электрических систем, так как она более эффективна, чем заземленная система.
5. Изолированная распределительная система предназначена для уменьшения опасности от токов короткого замыкания в опасных зонах, что может привести к взрыву легковоспламеняющегося груза.

6. Монитор должен быть установлен на главном и аварийном распределительных щитах, чтобы указать на наличие замыкания на землю.

Writing

Ex. 5. Write the short summary of the text (10-15 sentences).

Speaking

Ex. 6. Speak on the topic « Significance of earth faults».

Listening

Ex. 7. Listen to the text and fill the gaps.

1. An _____ _____ _____ causes the loss of service in this case of motor.
2. And the isolated switch is locked in the "_____" position.
3. First each phase is checked for the presence of voltage both between _____ and between _____ and _____.
4. Then each phase is checked by an _____ _____ _____ to earth and then for _____ _____.
5. Remember you always check for _____ _____ _____.
6. There may be more than one causing the _____.
7. The fault may be in the _____ but more often it's found in the _____ _____.
8. Now the cable _____ is cleaned.
9. The connection is remade making sure that the connection is clean and _____.

Ex. 8. Watch the video and answer the questions:

1. What fault was illustrated in this video?
2. How many faults can cause the breakdown?
3. What caused the fault in this video?

Grammar: Present Perfect and Present Perfect Continuous

A. Complete the sentences. Use Present Perfect or Present Perfect Continuous.

1. Is Henry still working? – No, he … (finish/already).
2. How long … (you / know) him? – Oh, for about ten years.
3. I'm sorry I'm late. … (you / wait) long?
4. How many times … (you / be) to the Far East? – Several times.
5. What … (you / do) this morning? - I … (paint) the bulkheads. I'll be finished this afternoon.
6. Why are you sweating so much? – Oh, I … (work out) in the gym for the past two hours.
7. … (you / phone) the office yet? – I … (try) for an hour but I can't get through.
8. Come quickly! There … (be) an accident. Peter … (break) his leg.
9. There you are! I … (look) for you for ages!
10. I wonder what they are discussing at the meeting. They … (talk) for hours.

B. Put these words in the correct order to make sentences. Put them in negative and question forms.

1. water / the / drained / manifold / motorman / has / all / from / the / scavenge.
2. have / aligning / the / crankshaft / they / all / morning / been.
3. I / already / cover / bolted to / the / the / cylinder / have.
4. the / for 2 hours / 2nd / been / fixing / the / fuel / pump / engineer / has / high / pressure.
5. fire / he / flange / connected / the / hose / to / the / has.

C. Circle the odd one out. Write a sentence with the circled word. Use Present Perfect or Present Perfect Continuous.

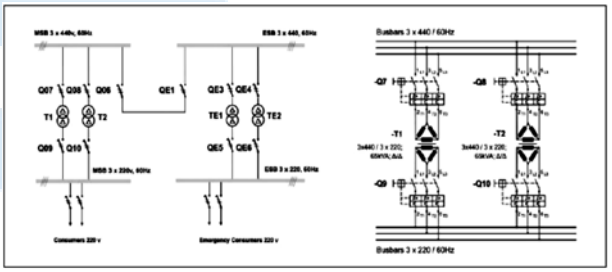
1. Hoist, lift, drop, raise.
2. Fix, repair, mend, damage.
3. Navigate, stop, steer, direct.
4. Dead, rescued, recovered, saved.
5. Binder, rope, folder, manual.
6. Water, extinguisher, blankets, fire.

UNIT 5. DISTRIBUTION CIRCUIT BREAKERS AND TRANSFORMERS

Lead-in

Describe what you can see in each photograph.

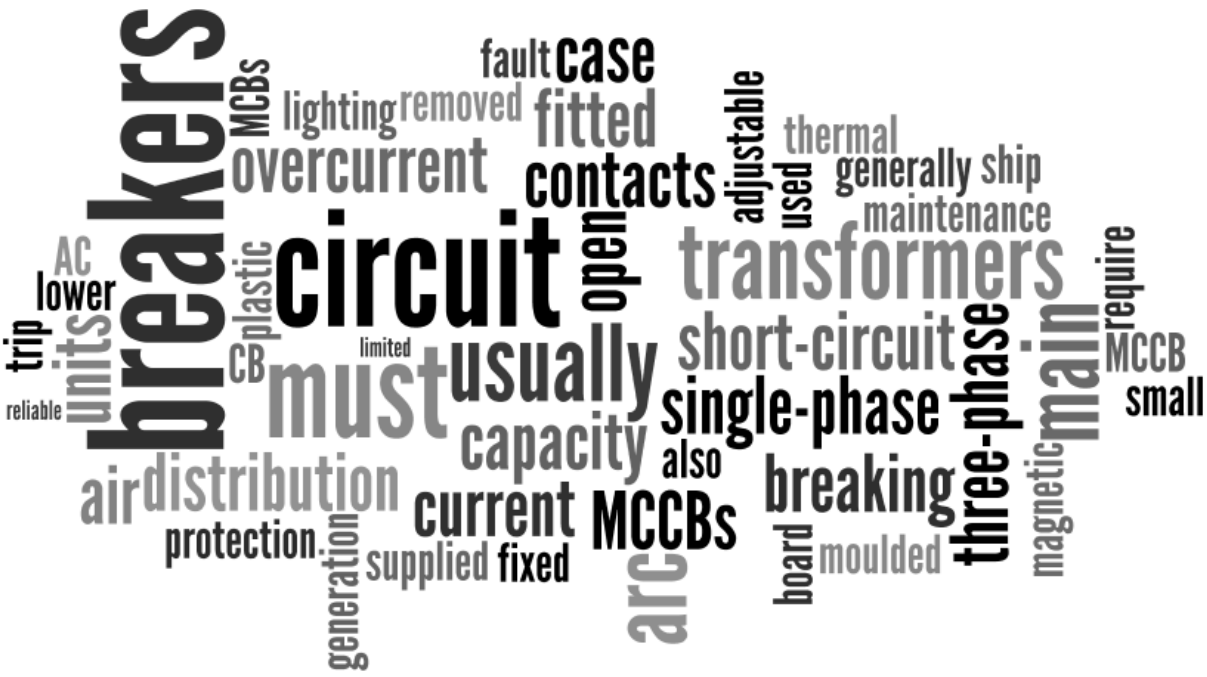
Power transformers connection



Vocabulary

remove capacity snap quench negligible adjacent tightness
rapidly arc arc chute arc splitter winding feeder deposit
moulded-case adjustable replacement cover dust resistance
coil spring closing gear reliable maintenance enclosure brush

Pre-reading vocabulary



Reading

Distribution circuit breakers

The function of any circuit breaker (CB) is to safely make onto and break open the prospective short-circuit fault current expected at that point in the circuit. The main contacts must open rapidly while the resulting arc is transferred to special arcing contacts above the main contacts. Arc chutes with arc splitters quickly stretch and cool the arc until it snaps. The CB is open when the arc is quenched.

Feeder and distribution circuits are usually protected by moulded-case (MCCB) or miniature (MCB) circuit breakers.

MCCBs. These are compact air circuit breakers fitted in a moulded plastic case. They have a lower normal current rating (50-1500 A) than main breakers and lower breaking capacity. They usually have an adjustable thermal overcurrent setting and an adjustable or fixed magnetic overcurrent trip for short-circuit protection built into the case. An undervoltage trip coil may also be included within the case. Operation to close is usually by a hand-operated lever, but motor-charged spring closing gear can also be fitted. MCCBs are reliable, trouble free and require negligible maintenance. MCCBs can be used for every application on board ship, from generator breakers to small distribution breakers.

MCBs. These are very small air circuit breakers fitted in moulded plastic cases. They have current ratings of 5-100 A and generally have thermal overcurrent and magnetic short-circuit protection. They have a very limited breaking capacity (about 3000 A) and are commonly used in final distribution boards instead of fuses. The DB is supplied via a fuse or MCCB with the required breaking capacity. MCBs must be replaced if faults develop – no maintenance is possible.

Transformers

Electric generation on board ship is typically at three-phase AC, 440 V, 60 Hz, while fixed lighting and other low power loads are supplied with 220 V AC single-phase from very efficient static transformer units. Ships with HV generation require three-phase transformers to supply the LV engine room and accommodation sub-switchboards, e.g. using 6600/440 V units.

The transformers are generally air cooled and mounted in sheet steel enclosures that are often located adjacent to the main switchboard. Three-phase 440/220 V lighting transformers are usually composed of 3 separate

single-phase units interconnected to form a three-phase arrangement. This enables easy replacement of a single-phase unit if it develops a fault.

At regular specific intervals, transformers must be switched off, covers removed and all accumulated dust and deposits removed by a vacuum cleaner and suitable brushes. Windings must be inspected for any sign of damage or overheating. Winding continuity resistance values are measured, recorded and compared with each other for balance. Cable connection must be checked for tightness.

Exercises

Ex. 1. Find the word or the phrase in the text:

a) распределение, автоматический выключатель, функция, прерывать, ток короткого замыкания, быстро, электрическая дуга, передавать, искрение/горение контактов, дугогасительная камера, дуговые разветвители, растягивать, охлаждать, остывать, вставать на место, гасить, питатель/фидер, распределительные сети, защищать, автоматический выключатель в литом корпусе, миниатюрный выключатель, установленный, отключающая способность/мощность переключения, регулируемый, тепловой, ток перегрузки, установки/настройки, магнитный, защита от короткого замыкания, ограниченный, пониженное напряжение, катушка отключения, включать/содержать, ручной рычаг, заряжаемая от мотора, пружинный механизм, надежный, бесперебойный, требовать незначительного технического обслуживания, применение на борту, автоматический выключатель генератора, номинальный ток, вместо, предохранитель, питаться через, требуемый, заменять, неисправность.

b) трансформатор, производство электроэнергии, трехфазный, переменный ток, освещение, нагрузка малой мощности, однофазный, трансформаторный блок, снабжать/питать, стальной корпус, состоять из, отдельный, объединенный, механизм, выключить, крышка, снять/удалить, пыль и отложения, щетка, обмотка, проверять, признаки повреждения или перегрева, измерять, герметичность.

Ex. 2. Answer these questions:

1. What is the function of any circuit breaker?
2. What is the function of arc chutes and arc splitters?

3. What is MCCB? What is MCB? What do they protect?
4. Describe MCCBs.
5. Describe MCB.
6. Can MCCB be used for every appliance on board ship?
7. What should you do if faults develop in MCB?
8. What is a typical electric generation on board ship?
9. Where can you find transformers on board ship?
10. Why do we need 3 separate single-phase units interconnected to form a three-phase arrangement?
11. What maintenance do transformers need?

Ex. 3. Are the sentences true or false?

1. The circuit breaker is closed when the arc is quenched.
2. Feeder and distribution circuits are usually protected by transformers.
3. MCCBs are very small air circuit breakers fitted in moulded plastic cases with current ratings of 5-100 A.
4. MCCBs are reliable, trouble free, require negligible maintenance and can be used for every application on board ship.
5. MCBs have a very limited breaking capacity and are commonly used in final distribution boards instead of fuses.
6. MCBs can be fixed if faults develop.
7. Electric generation on board ship is typically at three-phase AC, 440 V, 60 Hz.
8. The transformers are generally located adjacent to the main switchboard.
9. Once a month, transformers must be switched on and windings must be inspected for any sign of damage or overheating.

Ex. 4. Translate the sentences:

1. Функцией любого автоматического выключателя является защита от короткого замыкания.
2. Фидер и распределительные цепи защищены автоматическим выключателем в литом корпусе и миниатюрным выключателем.
3. Автоматические выключатели в литом корпусе имеют регулируемые настройки тока перегрузки и могут быть использованы для оборудования на борту судна.
4. Они надежны, бесперебойны и требуют незначительного технического обслуживания.

5. Миниатюрные выключатели имеют ограниченную отключающую способность (около 3000 А) и обычно используются в распределительных щитах вместо предохранителей.
6. Трехфазные трансформаторы состоят из трех отдельных однофазных блоков, соединенных между собой, для легкой замены в случае неисправности.
7. Через определенные промежутки времени трансформаторы должны быть выключены, крышки сняты, а пыль и отложения удалены с помощью пылесоса и щеток.

Writing

Ex. 5. Write the short summary of the text (10-15 sentences).

Follow the plan:
1. The function of a circuit breaker.
2. MCCBs.
3. MCBs.
4. Typical transformer on board.
5. Construction of the transformer.
6. Maintenance of the transformer.

Speaking

Ex. 6. Speak on the topic « Distribution circuit breakers and transformers».

Listening

Ex. 7. Listen to the text and fill the gaps.

1. This brings us to our last distribution fault which is a _____ _____ _____ shown on this drawing.
2. A _____ _____ _____ or _____ _____ are usually the first sign that the short circuit fault is developed in a circuit.
3. Do not reset the breaker or replace fuses before testing the circuit for _____ _____ and the _____ _____ of motor shafts.

4. Check the socket for _____, then reset the voltmeter to read _____ or use the insulation resistance tester and check the _____ _____ at the load side of the circuit breaker or fuse.
5. First check that the _____ is _____ before working on it.
6. _____ the damaged cable so that it can be removed.
7. Clean the _____ surface of the fitting.
8. Cut off the damaged part of the cable and _____ back the outer _____ about 6 or 7 centimeters or 3 inches to allow the cable to be reconnected.
9. Then _____ enough conductor to _____ proper and secure the electrical contact.
10. A loose connection will result in _____ and insulation _____ with further faults occurring.

Ex. 8. Watch the video and answer the questions:

1. What fault was illustrated in this video?
2. What is it important to remember about conductors while investigating the fuses and circuit breakers?
3. What should be done when the work is finished?

Grammar: If clause + will

A. Complete the warnings and predictions by matching the clauses in each column.

1. A vessel will need an Oil Record Book Part 2 if…
2. If clean ballast is discharged into sea,
3. You will be fined by the Coastguard if…
4. If a tanker doesn't have certification, …
5. Unless alternative energy sources are utilized, …
6. The population of dolphins will be endangered if …
7. If the correct topping-off methods are used, …
8. Marine pollution will be reduced further if…
9. If a master wants to transfer oil at night, …
10. If consumption of fossil fuels is not reduced, …

a) tank overflows will be avoided.
b) reserves will run out very soon.
c) greenhouse gas emission will keep rising.
d) more seafarers undergo MARPOL training.
e) he will need to make special arrangements with the harbor master.
f) it is a tanker of more than 150 GRT.
g) you knowingly pollute US waters.
h) it will not contain visible traces of oil.
i) it won't be allowed to sail.
j) they continue to get caught in fishing nets.

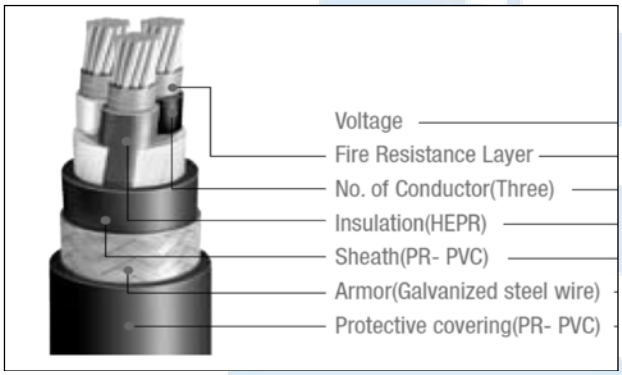
B. Complete these sentences with your own ideas.

1. If I won the lottery, …
2. If I had all the time in the world, …
3. If I had my life to live again,…
4. I would be a fluent English speaker if …
5. There wouldn't be any wars if …
6. … if I owned a fleet of vessels.
7. … if we didn't have radar on ships.
8. … if we had time to go ashore.
9. … if we didn't have electricity.
10. … if it rained all day.

UNIT 6. ELECTRIC CABLES

Lead-in

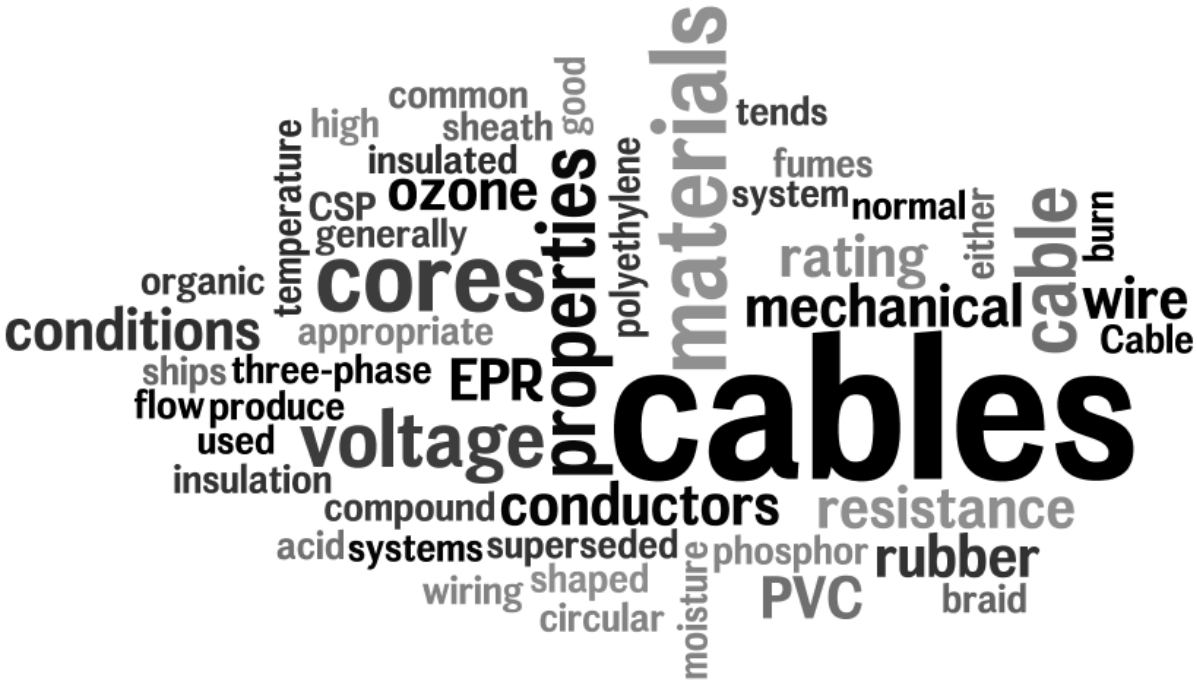
Describe what can you see in each photograph.



Vocabulary

cable improved durable galvanized steel variety grease annealed stranded copper circular braid compounds tough resilient heat moisture interference acid fumes rubber superseded appropriate core sheath gland distort abrasion

Pre-reading vocabulary



Reading

Electric cables

Ship wiring cables have to withstand a wide variety of environmental conditions. Improved materials have to lead to ship wiring cables of a fairly standard design that are safe, durable and efficient under all conditions.

The normal distribution voltage on ships is 440 V and cables for use at this voltage are designated 600/1000 V, i.e. 600 V to earth or 1000 V between conductors.

Higher voltage systems require cables with appropriate ratings, e.g. for a 3.3 kV three-phase earthed neutral system, the required cable rating is 1900/3300 V. For three-phase insulated systems, the cable rating would be 3300/3300 V.

Cable conductors are of annealed stranded copper, which may be circular or shaped. Cables with shaped conductors and cores are usually smaller and lighter than cables with circular cores.

Cable insulation has a thickness appropriate to the system voltage rating. Insulation materials are generally organic plastic compounds. Butyl rubber, which is tough and resilient, has good heat, ozone and moisture resistance. However, it has now been largely superseded by ethylene propylene rubber (EPR) insulation. EPR has similar electrical and physical properties to butyl rubber but with better resistance to moisture and ozone. It should not, however, be exposed to oils and greases.

Cross-linked polyethylene (XLPE) is also used as an insulator but has inferior mechanical and thermal properties when compared with EPR. Polyvinyl chloride (PVC) is not generally used for ships' cables, even though it is very common ashore. PVC tends to soften and flow at high temperature (melts at 150 C), and hardens and cracks at low temperatures (-8 C). Even at normal temperatures, PVC tends to flow and become distorted under mechanical stress – for example, necking occurs at cable glands, causing the gland to lose its watertight properties.

Multicore shipwiring cables have the cores identified by either color, printed numerals on untapped cores or numbered tapes on taped cores.

Polychloroprene (PCP or neoprene) is a common sheath material but has been largely superseded by chlorosulphonated polyethylene (CSP or hypalon). CSP-HOFR sheathing compound is well suited to shipboard conditions. It offers good resistance to cut and abrasions, resists weather, ozone, acid fumes and alkalis, and is flexible.

Extra mechanical protection is provided by armouring with basket-woven wire braid of either galvanized steel or tinned phosphor bronze. The non-magnetic properties of phosphor bronze are preferred for single core cables. A protective outer sheath of CSP compound covers the wire braid. The wire braiding also acts as a screen to reduce interference (caused by magnetic fields) in adjacent communication and instrumentation circuits.

Will cable materials burn? Yes. All organic materials will eventually burn in a severe fire. Some new materials do not produce acid fumes when burning but still tend to produce dense black smoke. Mineral insulated, metal sheathed cables (MIMS) are very useful in high temperature, fire-risk areas.

Exercises

Ex. 1. Find the word or the phrase in the text:

Электрический кабель, выдерживать, разнообразие, условия окружающей среды, улучшенный материал, долговечный, проводник, подходящие технические характеристики, прокаленный, многожильный, медь, круглой или определенной формы, ядро сечения, толщина, органические соединения из пластика, бутилкаучук, жесткий и эластичный, влажность, устойчивость, вытеснять, этилен-пропиленовый каучук, подвергаться воздействию масла и жира, высокомолекулярный полиэтилен, худший, поливинилхлорид, трескаться, искривляться, перетяжка/излом, кабельный ввод, свойства, полихлоропрен, оболочка, хлорсульфированный полиэтилен, трение, кислотные пары, щелочь, армирование, оплетка, помехи, смежные коммуникационные и измерительные цепи, плотный черный дым, кабель с минеральной изоляцией и металлической оболочкой.

Ex. 2. Answer these questions:

1. What is the function of ship wiring cables?
2. What are special features of ship wiring cable materials?
3. Describe the normal distribution voltage on ships.
4. What cables do higher voltage systems require?
5. What form can cable conductors be?
6. What insulation materials do you know?
7. What properties must insulation materials possess?

8. What are disadvantages of PVC material?
9. How can you identify the cores of multicore shipwiring cables?
10. What is a common sheath material?
11. Why was PCP superseded by CSP?
12. Will cable materials burn?
13. What cables are very useful in fire-risk areas?

Ex. 3. Are the sentences true or false?

1. Ship wiring cables have to withstand a wide variety of environmental conditions.
2. The normal distribution voltage on ships is 220 V and cables for use at this voltage are designated 400/600 V.
3. Cables with shaped conductors and cores are usually heavier than cables with circular cores.
4. Ethylene propylene rubber (EPR) insulation has been largely superseded by Polychloroprene.
5. The non-magnetic properties of phosphor bronze are preferred for multicore cables.
6. Cable materials aren't organic and never burn fire-risk areas.

Ex. 4. Translate the sentences:

1. Судовые электрические кабели должны выдерживать большое разнообразие условий окружающей среды.
2. Системы высокого напряжения требуют кабелей с соответствующими техническими характеристиками.
3. Кабельные проводники из прокаленной многожильной меди могут быть круглой или определенной формы.
4. Бутилкаучук имеет хорошую тепло-, озоно- и влагостойкость.
5. Поливинилхлорид обычно не используется для судовых кабелей, так как размягчается при высокой температуре и твердеет, трескается при низких температурах.
6. Хлорсульфированный полиэтилен подходит для судовых кабелей, так как имеет хорошую устойчивость к порезам, трению, кислотным парам и щелочи.
7. Все органические материалы горят при сильном пожаре, но некоторые новые материалы не производят кислотных паров при горении.
8. Кабели с минеральной изоляцией и металлической оболочкой используются в пожароопасных зонах.

Writing

Ex. 5. Write the short summary of the text (10-15 sentences).

Speaking

Ex. 6. Speak on the topic «Electric cables».

Listening

Ex. 7. Listen to the text and fill the gaps.

This concludes the subject of program 2 dealing with the practical aspect of the _____ _____. In this program we dealt with the massive safe distribution of the _____ _____ on board ship with all the safety system built in.

Next we dealt with _____ _____ and _____ _____. Then we traced and remedied an _____ _____ and an _____ _____ _____ and a _____ _____ _____. Special circuits within the distribution system such as steering gear _____ _____ and navigation lights _____ _____ are discussed in program 5.

We recommend that you watch this program again and you consult the book “Practical Marine Electrical Knowledge” which accompanies the series and will allow you to study the certain aspects in greater detail. Finally here is the list of the contents for all the programs of the series.

Ex. 8. Watch the video and answer the questions:

1. What did we deal with in program 2?
2. What will be discussed in program 5?
3. What does the narrator recommend?

Grammar: Passive Voice

A. Rewrite the sentences in Passive Voice.

1. The Cook prepares the food. The food … (is prepared by the Cook).
2. A steward cleans the officers' cabins every day. The officers' cabins.
3. Someone monitors the fuel levels regularly. The fuel levels …
4. A German company owns this vessel. This vessel …
5. Our ships transport oil from the Middle East. Oil …
6. A naval architect designed the ship. The ship …

B. Write questions in Present Simple Passive.

1. (where / the tools / keep)?
2. (how much / stevedores / pay)?
3. (how / wheat / transport)?
4. (what / radar / use for)?
5. (what goods / import / to the USA)?
6. (who / those machines / build by)?
7. (where / the ship / register)?
8. (supplies / order / on a daily basis)?

C. Put words in order to make questions in the Past Simple Passive.

1. fire / this / were / extinguishers / the / morning / checked ?
2. broken / what / vessel / up / in / the / year / was ?
3. 2007 / who / sold / in / to / was / the / vessel ?
4. funnels / why / shortened / were ship's / the ?
5. the / registered / under / was / flag / the tanker / Liberian ?
6. that / the / detained / why / ship / was / in / harbor ?
7. of / completed / when / the / was / ship / construction / the ?

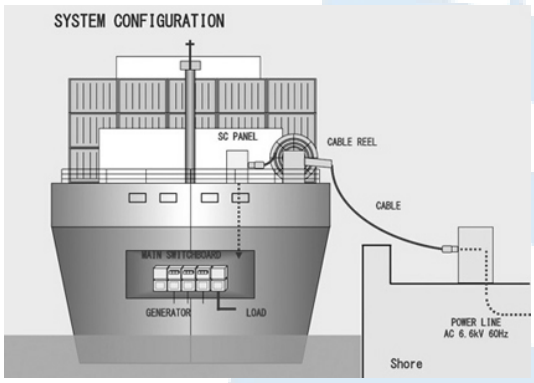
D. Use Present Simple Passive or Past Simple Passive.

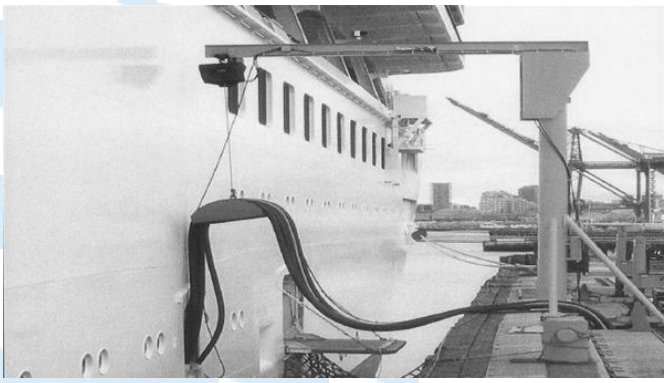
1. Luckily, the plane to Rotterdam … so you manage to catch your connecting flight. (delay)
2. The flight … due to technical difficulties 5 minutes ago. (cancel)
3. The cargo … at the docks. (load)
4. … the cargo … in containers or sacks? (transport)
5. The goods … by a customs official 2 hours ago. (check)

UNIT 7. SHORE SUPPLY CONNECTION

Lead-in

Describe what you can see in each photograph.





Vocabulary

shore supply prime mover connection overhaul entrance brief earthing terminal overheat phase-sequence indicator isolator busbar switchboard overloaded blackout sequence conveniently accelerate overstress stall differ dry dock suitable accept

Pre-reading vocabulary

Reading

Shore supply connection

A shore supply is required so that the ship's generators and their prime movers can be shut down for major overhaul during a dry docking period.

There must be a suitable connection box conveniently located to accept the shore supply cable. The connection box is often located at the entrance to the accommodation or in the emergency generator room. The connection box must have suitable terminals to accept the shore supply cable, including an earthing terminal to earth the ship's hull to the shore earth. The connection box must have a circuit breaker or an isolator switch and fuses to protect the cable linking the connection box to the main switchboard, with a data plate giving details of the ship's electrical system (voltage and frequency) and showing the method for connecting the shore supply cable. A voltmeter and a phase-sequence indicator (PSI) are fitted to indicate shore supply voltage and correct supply phase sequence. A phase-sequence indicator may incorporate either two lamps for “right” (R-S-T) and “wrong” (R-T-S) phase-sequence monitoring or a rotary pointer driven by an integrated small three-phase motor.

At the main switchboard, an indicator is provided (usually a lamp) to indicate that the shore supply is available for connection to the busbars via a connecting switch or circuit breaker. In general, it is impossible to parallel the shore supply with the ship's generators. The ship's generators must, therefore, be disconnected before the shore supply can be connected to the main switchboard.

Normally, the shore switch on the main switchboard is electrically interlocked with the generator's circuit breakers, so that it cannot be closed until the generators are disconnected from the ship's mains (as this will cause a brief mains blackout before shore power is applied).

The shore supply may have a different frequency and/or voltage to that of the ship's system. A higher frequency will cause motors to run faster, be overloaded and overheat a higher voltage will generally cause equipment to take excess current and overheat. It will also cause motors to accelerate more rapidly and this may overstress the driven loads a lower voltage is generally not so serious but may cause motors to run slower and overheat, or to stall. If the shore supply frequency differs from the ship’s normal frequency then, ideally, the shore supply voltage should differ in the same proportion.

Exercises

Ex. 1. Find the word or the phrase in the text:

Подключение питания на берегу, первичный двигатель, капитальный ремонт, период сухого дока, подходящий, принимать, соединительная коробка, вход, отделение аварийного генератора, заземляющий терминал, автоматический выключатель, изолятор, предохранитель, табличка, вольтметр, индикатор последовательности фаз, включать, поворотный указатель, управляемый трехфазным мотором, доступный, шина, отсоединять, соединять, блокировать, отключение электричества, являться причиной, ускорять, быстро, перенапряжение, нагрузка, перегреться, заглохнуть, отличаться, частота.

Ex. 2. Answer these questions:

1. Why is a shore supply required?
2. Where is a connection box located?
3. What should the connection box have to protect the cable linking the connection box to the main switchboard?
4. Why do we need a voltmeter and a phase-sequence indicator?
5. Is it possible to parallel the shore supply with the ship's generators?
6. What should be done before the shore supply can be connected to the main switchboard?
7. What can cause a brief mains blackout before shore power is applied?
8. What can happen if the shore supply frequency differs from the ship’s normal frequency?

Ex. 3. Are the sentences true or false?

1. The ship's generators and their prime movers must be shut down for major overhaul during a dry docking period.
2. The connection box must have a circuit breaker or an isolator switch and fuses to indicate shore supply voltage and correct supply phase sequence.
3. A phase-sequence indicator may incorporate either two lamps for “right” (R-S-T) and “wrong” (R-T-S) phase-sequence monitoring or a rotary pointer.

4. The shore switch on the main switchboard cannot be closed until the generators are disconnected from the ship's mains.
5. A higher frequency of the shore supply will cause motors to run slower and overheat, or to stall.
6. A lower voltage is generally not so serious.

Ex. 4. Translate the sentences:

1. Судовые генераторы могут быть остановлены на капитальный ремонт в течение периода сухого дока.
2. Соединительная коробка часто находится в помещении аварийного генератора.
3. Соединительная коробка должна иметь автоматический выключатель и предохранители для защиты кабеля, соединяющего соединительную коробку и главный распределительный щит.
4. Судовые генераторы должны быть отключены до подключения берегового питания к главному распределительному щиту.
5. Более высокая частота может привести к перегрузке и перегреву двигателя.
6. Более низкое напряжение может привести к тому, что двигатель заглохнет.

Writing

Ex. 5. Write the short summary of the text (10-15 sentences).

Speaking

Ex. 6. Speak on the topic “Shore supply connection”.

Listening

Ex. 7. Watch the video and answer the questions:

1. What is the golden rule of electrical safety?
2. Describe a typical electrical distribution system on board ship.
3. What distribution faults were illustrated in this video?
4. Describe the procedure for investigation an earth fault.
5. Describe the procedure for investigation an open circuit fault.
6. Describe the procedure for investigation a short circuit fault.

Grammar: Modal Verbs

A. Circle the phrase you think is correct.

1. We *must / have to* work harder to finish the job in time.
2. I am always late for work. I *must / have to* get up earlier.
3. You *mustn't/don't have to* drink and drive.
4. Crew *must not/don't have to* bring drugs on board.
5. You *should/ought to* see a doctor.
6. You *shouldn't/ought not to* run on wet decks.
7. In general people leave tips if they've enjoyed their meal but you *mustn't/you don't have to*.
8. In order to operate this machine you *should/you have to* have a licence.
9. You *ought not to / you don't have to* leave tools lying on a workbench because they can fall off in high seas.
10. You *mustn't / you shouldn't* attempt to repair electrical equipment if the power supply is still on.

B. Translate from Russian into English. Use can, may, must, should.

1. Вы сегодня можете быть свободным от вахты.
2. Я должен закончить эту работу до ужина.
3. Вам следует проинформировать капитана об этом инциденте.
4. Вы должны остановить двигатель как можно скорее.
5. Вам не следует запускать аварийный генератор в таком состоянии.
6. Когда вы стоите там, я не могу вас слышать.
7. Вы должны попросить о помощи, если не можете сделать это сами.
8. Могу я задать вам вопрос?
9. Следует ли мне начинать ремонт сейчас или лучше подождать?
10. Я не могу измерить силу тока в цепи.
11. Зазоры должны быть замерены при сборке мотора.
12. Номинальное напряжение постоянного тока на зажимах источника питания не должно превышать 230 вольт.
13. Вы должны проверить их работу.
14. Вам следует привести в порядок вашу форму.
15. Они смогут применить английский язык в рейсе.
16. При пожаре следует воспользоваться огнетушителем.

VOCABULARY

abrasion	истирание, абразивный износ
accelerate	ускорять
accept	принимать
acid fumes	кислотный дым
adjacent	примыкающий
adjustable	регулируемый, настраиваемый
allow	позволять
Alternating Current (A.C.)	переменный ток
annealed	калёная (проволока)
appropriate	подходящий
arc	дуга
arc chute	дугогасительная камера
arc splitter	дуговые разветвители
arcing	искрение, образование дуги
ashore	на берег
battery	аккумулятор, батарея
brief	краткий
blackout	отключение электричества
bonding	соединение
braid	оплетка
brush	щетка
busbar	шина
cable	кабель
capacity	ёмкость, производительность
cause	причина
circuit	цепь
circuit breaker	прерыватель тока, выключатель
circular	круговой
circulate	циркулировать
coil	катушка
compounds	смесь, состав, соединение
conductor	проводник
connect	соединять
connection	соединение
continuity	непрерывность
convey	передавать
copper	медь
core	сердечник
cover	крышка
conveniently	удобно
current	ток

deposit	отложение
device	устройство
diesel-driven	дизельный привод
differ	отличаться
Direct Current (D.C.)	постоянный ток
distort	искажать
distribution system	распределительная система
dry dock	сухой док
durable	прочный
dust	пыль
earth	заземление
earth fault	замыкание на землю
entrance	вход
earthing terminal	заземляющая клемма
electric shock	электрический шок
electrical power	электричество
emergency	аварийный
emergency generator	аварийный генератор
enclosure	ограждение
encounter	сталкиваться
equipment	оборудование
essential	необходимый
evacuation	эвакуация
event	случай
failure	сбой
fault	неисправность, повреждение
faulty circuit	неисправная цепь
feeder	фидер, питатель
fit	подгонять, прилаживать
flammable	легковоспламеняющийся
flow	поток
frequency	частота
fuse	предохранитель
galvanized steel	оцинкованная сталь
gland	сальник, уплотнение
grease	смазка, жир
ground	заземлять
hand cranked	коленчатый, изогнутый
hand-driven	с ручным рычагом
hazardous	опасный
heat	нагрев, тепло
High/Low voltage (HV/LV)	высокое / низкое напряжение
humidity	влажность

hydraulic accumulator	гидравлический аккумулятор
immediately	немедленно
impedance	полное сопротивление, импеданс
improved	улучшенный
insist	настаивать
install	устанавливать
installation	установка
insulated	изолированный
insulation	изоляция
intend	намереваться
interference	воздействие, вмешательство
internal combustion engine	двигатель внутреннего сгорания
item	пункт
isolator	изолятор
layout	раскладка
load	нагрузка
loose	свободный
loss of power	потеря мощности
main switchboard	главный распределительный щит
maintain	обслуживать
maintenance	техобслуживание
moisture	увлажнять
moulded-case	литой корпус
negligible	незначительный
neutral point	нейтральная точка
occur	случаться
overcurrent	предохранитель
overheat	перегрев
overloaded	перегрузка
overhaul	капитальный ремонт
overstress	перенапряжение
phase-sequence	фазовая последовательность
power supply	источник питания
prevent	предотвратить
permit	разрешить
prime mover	первичный двигатель
priority	приоритет
protective	защитный
provide	обеспечивать
quench	закаливать, охлаждать
rapidly	быстро
reduce	уменьшать
reliable	надежный

remove	удалять
render	приводить в какое-то состояние
replacement	замена
require	требовать
requirement	требование
resilient	упругий, эластичный
resistance	сопротивление
resistor	резистор, катушка сопротивления
rubber	резина
scheme	схема
self-contained	автономный
sheath	обшивка
ship’s hull	корпус судна
shore supply	питание с берега
short-circuit fault	короткое замыкание
significance	важность
sequence	последовательность
similar	похожий
snap	треск
source	источник
spring closing gear	пружинное закрывающее устройство
stall	глохнуть
steering gear	рулевой механизм
stranded	скрученный
substitute	заменять
suitable	подходящий
superseded	замененный
supply	подача, питание
switchboard	распределительный щит
through	сквозь
tightness	герметичность
tough	жесткий, плотный
transformer	трансформатор
trip	путь
watertight door	водонепроницаемые двери
winding	обмотка
wire	проволока
withstand	противостоять, сопротивляться

TEXTS FOR ADDITIONAL READING

THE DUTIES OF THE ELECTRICAL ENGINEER ABOARD A SHIP

The Electrical Engineer *is responsible to the Chief Engineer for*:
– *the maintenance of the vessel's electrical and electronic equipment, other than that detailed to* the Radio Officer;
– *the adoption of safe working practices* on board;
– where the vessel has no Radio Officer, the Electrical Engineer *is responsible for the first level maintenance of communication,* radio and navigation equipment.

* * *

is responsible to the Chief Engineer for – отвечает перед старшим механиком за …
the maintenance of the vessel's electrical and electronic equipment – обслуживание судового электрического и электронного оборудования
other than that detailed to … – которое не закреплено за …
the adoption of safe working practices – внедрение безопасных методов работы
is responsible for the first level maintenance of communication – отвечает за первый уровень обслуживания связи …

Text 1
Electric propulsion

Electric propulsion is basically the driving of a ship's *propeller shaft* by an electric motor, with the electric power for its being produced in one or more generators driven by steam propulsion, diesel engines using *residual fuel oil* or gas turbines. Early electric propulsion systems used direct current but modern systems use alternating current. With early alternating current systems the electric motor speed was changed by changing the speed of the *alternator* and the direction was changed by means of *switchgear*. This meant that the propulsion electrical generation system had to be separated from the system serving the rest of the ship. With a modern alternating current system the same electrical generation

plant generates power for the propulsion motors and the rest of the ship. The propulsion motor generally runs at a constant speed and the speed and direction of the ship are changed by means of *a controllable pitch propeller*.

The French ocean liner ***Normandie*** was fitted with electric propulsion; the generators being driven by steam turbines, a type of installation is known as turbo-electric. The advantage of this is that there no need for long *intermediate shafts* from the turbine, or diesel engine, to the propeller shaft, thus increasing the space available for cargo or other machinery. Also, unlike the conventional system, only the propulsion motor, not the machinery driving it, has to be in line with the propeller shaft. This means that the machinery can be located where convenient and, particularly in the case of passenger ships, it allows for large open space areas in the middle of the ship. The P&O liner ***Canberra*** had a turbo-electric propulsion system located at the after end of the ship with boilers and turbines above the *propulsion motors*.

The USA has had considerably more experience with electrical systems than in Europe and has used electric propulsion for many years in many types of ships. The aircraft carriers ***Lexington*** and ***Saratoga,*** built in 1927, had electric propulsion as did many American-built merchant ships of the period, including the Second World War T2 tankers. Today electric propulsion is used extensively in cruise ships, the installations being the diesel electric type where a number of medium-speed diesel engines, each driving an alternator, supply electric power. This electrical power is then used for the propulsion motors and the *ship's hotel services*, a transformer reducing the voltage of the electrical supply to serve the hotel needs. Large cruise ships need a lot of power for services such as lighting and air conditioning.

* * *

electric propulsion – гребная электрическая установка; электродвижение
propeller shaft – гребной вал
residual fuel oil – остаточное топливо, мазут
alternator – генератор переменного тока
switchgear – распределительное или коммутационное устройство
a controllable pitch propeller – гребной винт регулируемого шага , ВРШ
intermediate shaft – промежуточный вал
propulsion motor – репульсионный электродвигатель
ship's hotel services – хозяйственные службы на судне

Ex. I. Answer the questions on Text 1:

1. What is the title of the article?
2. What is this article about?
3. What is the main idea of the article?
4. What points does this article cover?
5. What is the definition of the electric propulsion?
6. What current was used by ships for early and modern electric propulsion systems?
7. How was the electric motor speed changed with early alternating current systems?
8. What are the advantages of the modern alternating current system?
9. What is the advantage of a type of installation known as turbo-electric?
10. How is the electrical power used in cruise ships nowadays?

Text 2
Vacon drive boosts bow thruster operation

An 800 kW AC drive from Finnish specialist Vacon has *boosted the in-port maneuverability* of the LNG carrier ***Abuja*** following *a retrofit project* on the *bow thrusters* carried out by Scotland- based Wärtsilä Automation.

A drawback of the original specification was that the motors driving the thrusters could not be started unless the main generators and hence the main steam turbines were running. Starting the thrusters imposed a significant mechanical load on generators and turbines, increasing wear on bearings and other components as well as producing a large voltage drop on the network.

Wärtsilä engineers determined that the *auxiliary gensets* had sufficient output to power the thruster drive motors while they were running but could not supply the much larger current required to start the motors. The motors were equipped with conventional electro-mechanical *star-delta starters* that gave an initial input of around 300 per cent of the motor's running current, and also generated another large current peak during the star-to-delta transition.

It was appreciated that a variable speed drive would foster much more controlled starting, with an *inrush current* limited to little more than the normal running current of the motors. A technical evaluation found that Vacon offered an attractive combination of price and performance for the 800kW drive

application. Furthermore, the drive's synchronization facility would make it easy to bypass when the thruster motors reached full speed.

LNG carrier ***Abuja*** features two bow thruster motors mounted on a common shaft. The variable speed drive is used to provide controlled acceleration for one of these, in such a way that the maximum current demand never exceeds 110 per cent of the motor's normal running current (well within the capacity of the auxiliary generators).

When the motor reaches full speed – as confirmed by the synchronization facility built into the Vacon drive – a contactor closes *to bypass the drive* and connect the motor directly to the supply. Such an arrangement means that no special provision has to be made for cooling the drive as it is only ever in use for short periods.

"*The versatility and performance* of the Vacon drives allowed us to offer a very convenient and cost-effective solution for the ship operators," reports Wärtsilä's Ian Gordon. "The results are excellent. The bow thruster can now be used whenever they are needed, and even started at short notice for maintenance operations without having to worry whether the main steam turbines are running."

* * *

boost the in-port maneuverability – повысить маневренность в порту
retrofit project – проект модернизации
bow thruster – носовое подруливающее устройство
drawback – недостаток
auxiliary gensets – вспомогательные генераторные установки
star-delta starter – пускатель со схемой звезда-треугольник
inrush current – пусковой ток
to bypass the drive – чтобы обойти привод
versatility and performance – многосторонность и эксплуатационные качества

Ex. I. Answer the questions on Text 2:

1. What kind of drive has boosted the in-port maneuverability of the LNG carrier Abuja?
2. What was the drawback of the original specification of the motors driving the thrusters?

3. What did Wärtsilä engineers determine about the power of the auxiliary gensets?
4. What were the advantages of a variable speed drive?
5. What attractive combination did Vacon offer for the 800 kW drive application?
6. How is a variable speed drive used aboard LNG carrier Abuja?
7. What can you say about the versatility and performance of the Vacon drives?

Text 3
Rolls-Royce launches *enhanced* IQ modules

A new Input/Output-box range from Rolls-Royce has been *released* to serve the more advanced control systems that have emerged in recent years.

IQ modules are key elements in all control systems, where physical measures and activation of actuators take place. Some read temperature, pressure, position, power and voltage, while others activate valves and start and stop pumps, for example. Demand for increased speed, accuracy and a higher degree of standardization stimulated Rolls-Royce to advance its programme.

"What is revolutionary with the new range is that it uses the same *software* for all systems and our customers will thus experience common control by using the same type of IQ-box for propellers, rudders, winches, steering gear and other equipment", says technical product manager Arve Sivertsen. "Customers will only need one type of box in their parts department".

A specification was defined and tenders invited to produce the boxes, which are planned for release this year. A new range of standardized *"touch" screens* for bridge mounting will also be offered to serve different purposes.

* * *

enhanced modules – расширенные модули
release – выпускать
software – программное обеспечение
"touch" screen – сенсорная панель/монитор

Ex. I. Answer the questions on Text 3:

1. What is the title of the text?
2. Do you agree that IQ modules are key elements in all control systems, where physical measures and activation of actuators take place?
3. What can IQ modules read?
4. What demands stimulated Rolls-Royce to advance its programme?
5. Why is a new Input/Output-box range from Rolls-Royce considered to be revolutionary?

Text 4
Torque and power monitoring extends green portfolio

Data from Kongsberg Maritime's new MetaPower *torque* and power monitoring system promotes *cost-effective operation* and *reduced CO2 and NO2 emissions* while maintaining or increasing ship speed. The system forms part of the Norwegian group's growing Green Ship product portfolio.

MetaPower measures the torque and power transferred from the main engine to the propeller, and also helps *to reduce maintenance* and extend engine life by comparing power output and *fuel consumption*. The information can also be applied to avoid over-stressing the engine.

Torque is measured by patented IR laser technology, reportedly delivering several *benefits* over conventional measurement systems. Since the system does not require sensitive electronics (*strain gauges*) glued to the shaft, it suffers no mechanical wear, no zero point drifting over time and is unaffected by *ambient temperature changes* or centrifugal forces.

Maintenance can be carried out by the crew, and the system is said to be easily re-installed after sterntube inspections.

A key element of the system, MetaPower Torsional Oscillation Analysis Software, is a tool for recording, measuring and analyzing variations in torque. The TOA software supports preventive maintenance planning and *remedial actions,* and facilitates detection of *operational disturbances* in an engine by showing differences in rotation frequency on a *sound* engine against that of an *engine misfiring on one of its cylinders.*

MetaPower can be supplied as a stand-alone installation or integrated with Kongsberg Maritime's K-Chief or AutoChief C20 monitoring and control systems. AutoChief also integrates AVL's engine

performance and optimization system (AVL EPOS) as well as other performance monitoring sensors.

* * *

torque – вращающий момент
cost-effective operation – рентабельная деятельность
reduced CO_2 and NO_2 emissions – снижение выбросов углекислого газа и диоксида азота
to reduce maintenance – уменьшить необходимость обслуживания
fuel consumption – потребление топлива
benefits – преимущества
strain gauge – тензодатчик, тензометрический датчик
ambient temperature changes – изменения температуры окружающей среды
remedial actions – восстановительные мероприятия
operational disturbances – эксплуатационные нарушения
sound – прочный, надежный, исправный
engine misfiring – осечка, перебои в зажигании двигателя

Ex. I. Answer the questions on Text 4:

1. What system forms part of the Norwegian group's growing Green Ship product portfolio?
2. What are the innovations of the MetaPower?
3. How is the torque measured by according to the text?
4. How can the maintenance of the system be carried out?
5. What can you tell about MetaPower Torsional Oscillation Analysis Software?
6. How can MetaPower be supplied?

Text 5
Automatic connection offers faster and safer shore power

Although it has been possible for many years, taking electrical power from a shoreside facility while at the berth has not been widely accepted by

commercial shipping. France based New Generation Natural Gas (NG_2) has been developing *solutions* for the wider shipping industry and has recently launched an innovative *shore power* connecting system. According to NG_2, the Power Generation during Loading and Unloading system (PLUG) is the world's first, multi mega watt, high voltage shore power connection that can be safely connected within a minute.

The connection between ship and shore is fully automated. *A hoisting chain* fitted with a *shuttle bar* is remotely lowered into the *capture mechanism* on the quay. Operated by a crew member from onboard the ship, the shuttle bar is caught by the capture mechanism and the whole assembly including the power cables is lifted to the *retractable socket* in the ship's side. At this point the shuttle bar engages *a set of rollers* that automatically *aligns the 3-phase connectors.*

Connection can be achieved within one minute and a single unit can provide a power exchange capability of 11 kV/700 A. This removes the need for man-handling heavy cables and reduces the risk of injury to personnel during connection. Current shore power solutions for cruise ships up to six people to complete a connection that takes, on average, around 45 minutes, says the company. This means that if the ship is in port for 8 hours it could spend 90 minutes connecting and disconnecting shore supply while the generators are still on load. Using the PLUG system could considerably reduce this time resulting in fewer emissions and *increased fuel savings*. The amount of fuel saved could be as much as 3-tonnes and this would have a positive impact on *the return of investment* in both financial and environmental terms.

The NG_2 admits that there are challenges associated with shore supply power such as the different frequencies of the supply in Europe and that of the USA and the investment required by port authorities to install a reliable infrastructure. However, the first unit is being manufactured to demonstrate it can meet IEC standards and satisfy classification society requirements for shore power systems.

* * *

solution – решение
shore power – энергия, подаваемая на судно с берега (или плавучей базы)
hoisting chain – подъемная цепь
shuttle bar – узел с возвратно-поступательным движением
capture mechanism – механизм захвата

retractable socket – выдвижная розетка
a set of rollers – набор роликов
align the 3-phase connectors – выравнивать трехфазные соединители
increased fuel savings – увеличенная экономия топлива
return of investment – возврат инвестиций

Ex. I. Answer the questions on Text 5:

1. What company has recently launched an innovative *shore power* connecting system?
2. Can you name the world's first, multi mega watt, high voltage shore power connection that can be safely connected within a minute?
3. Can you describe the automated process of the connection between ship and shore?
4. Connection between the ship and shore can be achieved within one minute, can't it?
5. What are the advantages of this connecting system?
6. What are current shore power solutions for cruise ships up to six people to complete a connection?
7. What could be the amount of fuel saved using the PLUG system?
8. Would using the PLUG system have a positive impact on the return of investment in both financial and environmental terms?

Text 6
Isochronous or speed droop control for gensets?

Electric loading on generators – active loads (kW) and reactive loads (kVar) – is required by rules and regulations to be equally shared between paralleled gensets in the plant. This means that two equally-sized gensets shall have the same load in kW and kVar within the tolerance defined by classification rules.

Gensets of different sizes share the loadings to an equal percentage of their ratings. The load sharing should be automated but with the possibility of unequal sharing for test purposes or if dictated (for example, after lengthy periods of low load operations).

Reactive load sharing is controlled by an automatic voltage regulator (AVR). The generator voltage in ship network is allowed to vary, typically up to 5 per cent. Exploiting this freedom, and by using digital ACR with high resolution and performance, voltage regulation is made by setting the AVR in droop control, allowing the voltage to reduce with increasing reactive load.

By equal setting of the voltage reference value Vref, and the droop Dv, the two parallel generators will share the reactive load equally.

There are some solutions for sharing the reactive load equally without voltage variations, but this requires communication between the AVRs and hence increased complexity and potentially common fault modes. Since the operation, synchronization and performance of the electric power plant for most installations will tolerate a small voltage variation, voltage droop control without droop compensation is overwhelmingly the most common solution for ships.

Active load sharing is controlled by the diesel engine speed controllers (governors). Controlling the speed of an engine also directly controls the frequency of the synchronous generator. The engine may be well controlled in *speed droop* control, similar to the voltage droop control of the generators. The loads of the plant may vary significantly.

Large power variations in the load are challenging for the engine controller and will cause frequency variations. While the voltage variations from droop control of the generators normally do not have a *detrimental impact* on the operations of the electric system, large frequency variations will create higher losses in the plant and may also make synchronization of generator more difficult.

This is the case even if the speed reference is being adjusted by the power management system, as this compensation of the droop is normally slow.

An isochronous speed controller will not eliminate frequency variations due to its *control bandwidth* but it reduces the excursions from the set point quite efficiently for most normal load variations.

The characteristics of these methods can be summarized as:

Drop mode:

- larger frequency variations with varying loads;
- lower margins to over- or under- frequency trips (can be compensated by power management speed reference adjustments);
- no single point of failure in the controllers: if the power management system has an overall load sharing control and speed reference adjustment, a failure there has no instant on the power plant.

Isochronous mode:

- quick response to load changes/frequency variations;
- stable net frequency, even with variable loads, ensuring larger margins to critical under- and over-speed limits;
- asymmetric load sharing requires additional functionality (for example, mode change);
- failure in load sharing line (earth failure, short circuit) may be a single point of failure;
- monitoring of load sharing line is required with automatic switching to droop mode when a fault is detected.

At each type ship has different operational requirements and load characteristics it is not easy to declare which method is better.

For many ship types – especially smaller vessels where the thruster and propellers may be strongly disturbed by the water motion and air suction in harsh weather – the use of an isochronous speed control system is more common. This stabilizes the network frequency and simplifies synchronization of generators and bus ties in such weather.

To increase the flexibility of controls, the generators are normally equipped with a mode change capability that also enables operation in speed droop.

For other ship types, such as drilling vessels, the thrusters are less exposed to the weather impact and, even with large variations in the process loads, speed droop is usually used. Normally, the automation system's power management is allowed to adjust the speed reference to keep the frequency more stable and close to the set point, and thereby also increasing the margins to over- and under- frequency trip limits.

* * *

isochronous – изохронный (равномерный)
reactive load sharing – реактивное распределение нагрузки
speed droop – степень неравномерности регулирования; статизм регулиро-вания скорости (турбины); падение скорости
detrimental impact – пагубные последствия
control bandwidth – управление пропускной способностью: регулировка ширины полосы пропускания
excursions – отклонения

Ex. I. Answer the questions on Text 6:

1. What electric loads are required to be equally shared between paralleled gensets in the plant?
2. Gensets of different sizes share the loadings to an equal percentage of their ratings, don't they?
3. What is reactive load sharing controlled by?
4. Are there any solutions for sharing the reactive load equally without voltage variations?
5. How is active load sharing controlled by?
6. Will large power variations in the load of the engine cause frequency variations?
7. Can drop mode produce any failure in the controllers?
8. What are the basic characteristics of isochronous mode?
9. For what vessels is the use of an isochronous speed control system more common? Why?
10. What types of ships prefer to use speed droop?

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АНГЛИЙСКИЙ ЯЗЫК ДЛЯ СУДОВЫХ ЭЛЕКТРОМЕХАНИКОВ: ЭЛЕКТРИЧЕСКАЯ РАСПРЕДЕЛИТЕЛЬНАЯ СИСТЕМА

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ENGLISH FOR ELECTRICAL ENGINEERS: ELECTRICAL DISTRIBUTION SYSTEM

Учебное пособие
для студентов и курсантов
старших курсов
судомеханических факультетов
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