Electrical Safety Guidelines

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TABLE OF CONTENTS

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1 Purpose/Scope

This document details the “Electrical Safety Guidelines” for the Azerbaijan Strategic Performance Unit.

The “Electrical Safety Guidelines” identify current best practice with regard to Electrical Safety.

This document is part of the “Safe System of Work” Energy Isolation (electrical) (AZSPU-HSSE-DOC-00048-2**)** and will apply across the Azerbaijan Strategic Performance Unit and will be used both offshore and onshore in Azerbaijan and Georgia.

This procedure is written in sufficient detail to enable it to be applied consistently at all sites or installations. There may still be the requirement for some site-specific instructions covering logistical & administrative arrangements, and site-specific variations in responsibilities to reflect differences in organisational arrangements. These site-specific instructions should not deviate from the core processes within this document. Any form of deviation from this procedure, including but not limited to site-specific instructions, shall be requested and authorised in accordance with the AzSPU Deviations Procedure (AZSPU-HSSE-DOC-00011-2).

2 Definitions

Refer to document AzSPU-HSSE-DOC-00021-2 HSE Definitions for definitions common to this procedure. Definitions specific to this Procedure are included below.

Circuit conductor	Means any conductor in a system which is intended to carry electric current in normal conditions, or to be energized in normal conditions, and includes a combined neutral and earth conductor, but does not include a conductor provided solely to perform a protective function by connection to earth or other reference point.
Conductor	Means a conductor of electrical energy.
Danger	Means risk of injury.
Dead	Dead means at or about zero voltage and disconnected from any source of electrical energy.
Temporary earth	A temporary earth, is one which is applied to electrical equipment to maintain otherwise non-earthed equipment at earth potential for the duration of an activity.
Earthed	Earthed, means connected to the general mass of the earth, in such a manner, as will ensure, at all times, an immediate discharge of electrical energy without danger.
Electrical equipment	Includes anything used, intended to be used or installed for use, to generate, provide, transmit, transform, rectify, convert, conduct, distribute, control, store, measure or use electrical energy.
Non Hazardous areas	A non hazardous area, is an area in which flammable atmospheres are not expected to be present, so that special precautions for the construction, use and maintenance of electrical apparatus, are not required.
Hazardous areas	A hazardous area is an area in which flammable atmospheres may be present, requiring that special precautions for the construction, use and maintenance of electrical equipment, are required.
Injury	Means death or personal injury from electric shock, electric burn, electrical explosion or arcing, from fire or explosion initiated by electrical energy, where any such death or injury is associated with the generation, transmission, transformation, rectification, conversion, conduction, distribution, control, storage, measurement or use of electrical energy.
Live	Live means ‘electrically charged’.
System	Means an electrical system in which all the electrical equipment is, or may be, electrically connected to a common source of electrical energy, and includes the equipment.
High voltage	Normally exceeding 1000volt ac or 1500 volt dc between electrical conductors, or 600volt ac or 900 volt dc between conductor and earth.
Low voltage	Normally exceeding extra low voltage but not exceeding 1000 volt ac or 1500 Volt dc between electrical conductors or 600 volt ac or 900 Volt dc between conductor and earth.

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Reduced low voltage	Shall not exceed 55Volt ac between electrical conductor and earth.
Extra low voltage	Normally not exceeding 50 Volt ac or 120V dc whether between electrical conductors or to earth.
RF	Radio Frequency
EED	Electro Explosive Devices
NDB	Non Direction Beacon

3 General Requirements

3.1 Stopping Unsafe Work

To stop the continuation of potentially unsafe work at the earliest possible stage, the Control of Work (CoW) Policy and this guidelines for Electrical Safety make it very clear that all personnel are obliged and have the authority to **"STOP"** the work that they consider to be unsafe.

3.2 Legislation & Standards

This procedure complies with applicable national law. Applicable national law is national law as amended by project specific agreements, e.g. the ACG Production Sharing Agreement (PSA), and relevant International Conventions, if any, in force in Azerbaijan or Georgia, as applicable.

In the absence of national legislation, or where national legislation is inconsistent with the requirements of project specific agreements, BP Group Standards or applicable requirements from UK or US legislation will be complied with.

Where requirements conflict, legal advice has been obtained and a defendable compliance position adopted.

The standards and practices contained in this procedure are consistent with those internationally recognized within the petroleum industry.

4 Key Responsibilities

Asset/Operations Managers will be responsible for:

- Ensuring that all persons engaged in work with electricity are familiar with this document.
- Ensuring, site management have an overview of this document.

5 Guidelines for Electrical Safety

This document is made up of a number of guidelines, each covering an area of electrical safety, which may be associated with either an activity, or a specific type of equipment. These guidelines need to be general in order to cover a wide range of equipment and activity. They may be used as stand alone, but when considering specific activities or equipment it is more beneficial to use in conjunction with the site risk assessment process.

5.1 Applicability

All sites / Installations

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5.2 Guidelines

These guidelines represent current best practice in electrical safety. They may be used stand-alone or in-conjunction with a site risk assessment.

5.2.1 Guidance - Electrical Shock

This guideline gives information on electrical shock and possible first aid treatment.

5.2.1.1 Hazard

Lightning or electric current causes electric shock injuries from passing current through the human body.

5.2.1.2 Causes and symptoms

The severity of injury depends on the current's pressure (voltage), the amount of current (amperage), the type of current (direct vs. alternating), the body's resistance to the current, the current's path through the body, and how long the body remains in contact with the current. The interplay of these factors can produce effects ranging from barely noticeable tingling to instant death. Every part of the body is vulnerable. Although primarily the voltage determines the severity of injury, low voltage can be just as dangerous as high voltage under certain circumstances. People have been killed by shocks of just 50 volts.

How electric shocks affect the skin is determined by the skin's resistance, which in turn is dependent upon the wetness, thickness, and cleanliness of the skin. Thin or wet skin is much less resistant than thick or dry skin. When skin resistance is low, the current may cause little or no skin damage but severely burn internal organs and tissues. Conversely, high skin resistance can produce severe skin burns but prevent the current from entering the body.

The nervous system (the brain, spinal cord, and nerves) is particularly vulnerable to injury. In fact, neurological problems are the most common kind of non-lethal harm suffered by electric shock victims. Some neurological damage is minor and clears up on its own or with medical treatment, but some is severe and permanent. Neurological problems may be apparent immediately after the accident, or gradually develop over a period of up to three years.

Damage to the respiratory and cardiovascular systems is most acute at the moment of injury. Electric shocks can paralyse the respiratory system or disrupt heart action, causing instant death. Also at risk are the smaller veins and arteries, which dissipate heat less easily than the larger blood vessels and can develop blood clots. Damage to the smaller vessels is probably one reason why amputation is often required following high-voltage injuries.

Many other sorts of injuries are possible after an electric shock, including cataracts, kidney failure, and substantial destruction of muscle tissue. The victim may suffer a fall or be hit by debris from exploding equipment. An electric arc may set clothing or nearby flammable substances on fire. Strong shocks are often accompanied by violent muscle spasms that can break and dislocate bones. These spasms can also freeze the victim in place and prevent him or her from breaking away from the source of the current.

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5.2.1.3 **Treatment**

When an electric shock accident happens in the workplace:

The main power should immediately be shut off. **INFORM THE CONTROL ROOM**. Emergency medical help should be summoned as quickly as possible. People who are trained to perform first aid should, if appropriate, use an 'insulated shepherd's crook' to pull the victim away from the de-energized conductors and begin first aid while waiting for emergency medical help to arrive.

If the main power cannot be shut off, and current is still flowing through the victim. **INFORM THE CONTROL ROOM**. The victim and the source of the current must not be touched while the current is still flowing, for this can electrocute the rescuer. Keep personnel away until the main power can be shut off.

Note: If the voltage level is less than 1000V then the victim maybe pulled away from live conductors using an appropriate shepherd crook and standing on a dry rubber mat, but if there is any doubt about the voltage level or if the environment is wet or there is any other condition which makes this action unsafe for the rescuer that person must stand clear until the main power is shut off.

First aid for electrical injuries includes the following:

1. Remove the worker from the heat and put out the fire on any clothing by smothering the flames with a blanket. Make sure that the fabric is no longer smouldering.

2. Initiate priority action by following the ABC approach
    a. Air way: establish and maintain an open airway
    b. Breathing: Check and maintain breathing. If the injured worker is not breathing, start assisted ventilation (using mouth to mouth or a pocket mask)
    c. Circulation: monitor the worker's circulation constantly. Initiate cardiopulmonary resuscitation (CPR) if necessary, and carry on until more advanced life support is obtained. Electrical workers should be familiar with CPR.

3. Keep the injured worker warm and at rest.
4. If the injured worker is conscious, offer reassurance.
5. If the injured worker vomits, turn the worker onto one side to keep the airway clear.
6. Transport the injured worker to medical aid. While waiting for transport or en route to medical aid, administer first aid for burns (see below)
7. Do not leave injured workers unattended. Maintain a constant watch on their airway, breathing, and circulation while they are transported to medical aid

First aid for burns:

1. Remove rings, wristwatches, and footwear if possible
2. Elevate burned extremities, if possible, to decrease fluid loss. Do not splint burned limbs unless there is an obvious fracture or dislocations.
3. Avoid handling the affected body parts unnecessarily.
4. Apply wet dressing on burns to less than 20 % of the body surface. Any burns in excess of 20% can be covered with dry dressings or clean sheets. Do not apply tight, encircling dressings.
5. Do not break blisters.

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6. Do not apply creams, ointments, or other medications to the burned area.
7. Do not examine burned eyelids. Cover them with sterile dressings until they can receive specialized treatment

5.2.1.4 **Prognosis**

Electric shocks cause death in 3-15% of cases. Many survivors require amputation or are disfigured by their burns.

5.3 Guidance - Risk of Electrical Tasks

This process is to help provide consistency when considering risk of electrical work. It may be used as part of the formal risk assessment process or stand-alone

Criticality of Electrical Tasks		Score
Note: See Section 8.16.1 to guidance on Electrical task descriptions		
Exposure to	**High Voltage**	**4**
	Low Voltage	**3**
	Extra Low Voltage	**2**
	No exposure	**1**
	Isolated & no exposure	**0**
Fault Level:	**Greater than 20 kA**	**4**
	5 - 20 kA	**3**
	1 - 5 kA	**2**
	Less than 1 kA	**1**
	Isolated & no exposure	**0**
Type of Work	**Fault Finding**	**4**
	Testing	**3**
	Routine Maintenance	**2**
	Operation	**1**
Accompanied	**Not Accompanied**	**4**
	Yes - not Electrical	**3**
	Yes - Electrical not standing by	**2**
	Yes - Electrical and standing by	**1**
Location	**Outside – Constrained**	**4**
	Inside – Constrained	**3**
	Outside – Non- Constrained	**2**
	Inside – Non-constrained	**1**

The total score for risk factor is obtained by addition of the scores for; Exposure to voltage, Fault level, Type of work, Accompanied and Location.

Total Scores	Description	Risk factor
15 – 20	Fatality possible	VH
12 - 14	Permanent Injury possible	H
9 – 11	Minor Injury possible	M
3- 9	Minor injury possible on site first air treatment	L

The above description provides outline the general principles for identifying the appropriate score but where the competent person, from experience and knowledge of the plant, site and task, feels the score to be inappropriate, then he may assign a level either higher or lower as necessary. For example working on live equipment carries risk to personnel and plant. It is generally accepted that at extra low voltage

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the risk to personnel from the electric shock is unlikely to cause injury. However, there may be circumstance when consequences of an electric shock may be dangerous, e.g. working on ladders and scaffolding. Risk of ignition of flammable atmospheres should be considered to be possible at all voltages however this is handled separately under the Guidance - Work In Hazardous Areas.

If the final risk factor is considered high or very high then the work should be reconsidered or other precautions sought.

It is recommended that each site records risk assessment outcomes for site-specific tasks that are likely to be repeated. These safety precautions can be used in the future.

5.3.1 **Comments on Descriptions**

5.3.1.1 Exposure to Voltage:

Voltage includes low voltage control circuitry and equipment, and adjacent exposed conductors that may present a hazard. Adjacent working assessment to be used to assess the risk (This can be found in procedure energy isolation – electrical)

5.3.1.2 Fault Level:

An accurate level is not required but should be based on the maximum level attainable for the voltage that is being worked on unless the detailed values are known.

5.3.1.3 Type of Work:

Fault Finding
This covers activities where no formal procedures are available.

Testing:
This covers tests using a megger, multimeter, avometer or similar instruments requiring the application of test leads.

Routine Maintenance:
Following manufacturer's instructions or P.M.(Preventative Maintenance) routines.

Operational:
This includes the starting and stopping of equipment, racking in and out of circuit breakers, replacement of lamps in fittings.

5.3.1.4 Accompanied:

This is to be considered as that which would normally occur for the task to be carried out.

Not Accompanied:
The Competent Person would normally carry out the task alone.

Yes – but not electrical competent:
The accompanying person would be trained in dealing with an injury arising from electric shock or burn.

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Yes - electrical but not standing by:
In this situation the accompanying person is electrical competent but carrying out other tasks in the same area. They should still be in general sight and sound contact with the person carrying out the task.

Yes - electrical and standing by:
When the accompanying person is also an electrical competent person and is not carrying out any other tasks but whose function is to add to the safety of the person carrying out the task.

5.3.1.5 Location:

Note: Hazardous area implications will be considered and covered under the permit and will not be considered here

Outside Constrained:
This area is one where space could be restricting the activities. It could also apply to work on scaffolding or ladders. It could also apply to areas where lighting levels are poor. It may also apply to semi-open modules, or modules with louvers.

Outside Non-Constrained:
This area is one where space is not a problem for the task, where there is plenty of light. It may also apply to semi-open modules, or modules with louvers.

Inside Constrained:
This area is one where space could be restricting the activities. It could also apply to work on scaffolding or ladders. It could also apply to areas where lighting levels are poor.

Inside Non-Constrained:
This area is one where space is not a problem for the task, where there is plenty of light.

5.4 Guidance - Work on Live Equipment (Testing)

Live working will not be done unless it is unavoidable and it is unreasonable to work dead and it is reasonable to work live and suitable precautions are taken to prevent injury.

An example of work that has to be done live would be work on batteries, which by design are always a source of energy. Another example would be live testing which needs to be energized to prove voltage levels etc.

If live work is to be done then a risk assessment is required to identify hazards and precautions to reduce risk to personnel.

5.4.1 **Hazards - Live work**

The hazards to be considered shall include but not be limited to:

- Contact with live conductor and another conductor of another phase or earth.
- Direct personal contact leading to electrocution.

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- Indirect contact leading to electrical arcing (causing electrical explosion the size of which is in proportion to the local fault level and the duration of the fault).
- Chemical burns from batteries.
- Falls from ladders or platforms when live working.

5.4.2 **Precautions - Live work**

Some precautions to be considered:

- Competent personnel.
- Adequate information for the task.
- Suitable tools including insulated tools and equipment
- Protective clothing and Gloves.
- The use of suitable insulated barriers or screens (these may be used to prevent inadvertent contact with sheaths or other conductors while working on phases).
- The use of suitable instruments and test probes (insulated tools and test equipment).
- Accompaniment by another person or persons if the presence of such person or person could contribute to ensuring that injury is prevented.
- Effective control of any area where there is danger from live conductors (use of barriers etc).
- Personnel not to wear any exposed metal (jewellery to be removed, zips on coveralls to be covered etc).
- Reducing voltage levels if possible (i.e. reducing voltage level of batteries by splitting the battery).

5.4.2.1 Insulated Tools

All insulated tools should be suitable for the peak voltages that would normally be expected on the system that they are to be used on. Insulated tools should be inspected before use to check for any damage or foreign material, which may affect the insulating properties of the tool. The voltage rating of insulated tools should be clearly marked on them.

5.4.2.2 Temporary Insulation

Where there is risk from contact with a hazardous conductor, it cannot be assumed that personnel will be able to avoid accidental contact. Consider using temporary insulation that may be in the form of purpose-made screens, insulating sheets or shrouding (rigid or flexible).

5.4.2.3 Test Equipment

Where possible, Class II double insulated equipment should be used, as this equipment is earth free. All test equipment should be suitably rated for the peak voltage normally expected on the system and will as a minimum have over voltage protection to a CAT III standard as defined in EN61010.
Test probes and leads are to have:

- Finger barriers to prevent inadvertent hand contact with the live conductors under test.
- Insulation leaving an exposed metal tip not exceeding 4mm measured across any surface of the tip. Where practicable it is strongly recommended that this

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is reduced to 2mm or less, or that spring-loaded retractable-screened probes are used.

- A suitable high breaking capacity (HBC) sometimes known as a HRC fuse, or fuses with a low current rating (usually not exceeding 500mA or current limiting resistor and a fuse), or some other form of energy limitation. This requirement is a must for voltage measurements, however in some instances for small current measurements the additional impedance of the fuse in the lead affects the measurement and therefore un-fused leads may be used. Where the maximum systems fault level exceeds the fault rating of the fuse then the work is to be risk assessed before proceeding.

The leads:

- Must be adequately insulated (choice of insulating material may be influenced by the environment in which the leads are to be used).
- Must be coloured so that one lead can be easily distinguished from the other.
- Must be flexible and have sufficient capacity for the duty expected of them.
- Must be sheathed to protect against mechanical damage.
- Must be long enough for the purpose while not so long that they are clumsy or unwieldy.
- Do not have accessible exposed conductors other than the probe tips, or have live conductors accessible to a person's finger if a lead becomes detached from a probe, indicator or instrument when in use. The test lead or leads are held captive and sealed into the body of the voltage detector.

Voltage testing of equipment to prove circuits dead should be done using an approved voltage only indicator or meter, this indicator being proven by an approved proving unit immediately before and after testing.

Note: use of mains voltages to prove a tester is not considered acceptable: as proving the voltage tester should be done as close to the point of work as possible. Exposure to mains voltage should be avoided where possible.

Note: Multi-meters may not be used for proving dead due to the risk of equipment failure when incorrectly ranged while testing.

5.4.2.4 Accompaniment of Personnel

Work that will normally need personnel to have accompaniment includes:

- Work on Battery systems.
- HV testing or faultfinding.
- LV faultfinding on live systems upstream of 32A Fuses.

Any other work, which the permit or the risk assessment identifies as requiring accompaniment.

The accompanying person must be able to provide assistance in the event of an emergency. This will normally include but not be limited to:

- Isolation of the circuit from an isolation point(s) agreed prior to commencement of the work,
- Informing the control room of an incident,
- Providing initial rescue first aid if required,
- Use of fire extinguishers as required.

At no point should the accompanying persons endanger themselves in the execution of the above duties.

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5.4.2.5 Pre Testing Checks

Before any testing is carried out the following shall be checked:

- The equipment, which is to be worked on, is safe for the intended tests.
- The working environment does not present additional dangers. These dangers include: inadequate space to work safely; insecure footing, insufficient light, potentially flammable gases or vapours, explosive or conductive dusts, risk from adjacent live conductors.
- Where using a tong tester, ensure that there is adequate room to work safely.
- Check that all equipment to be used is adequately insulated.

5.5 Guidance - Electrical Equipment Used In Wet Areas

Electrical Equipment will not be used in a wet area unless designed for this duty

5.5.1 **Hazards - Electrical Equipment in Wet Areas**

Personnel using electrical leads and tools in wet areas are at risk of electrical shock injuries. Two factors contribute to this:

- Water can be a good conductor
- When area is wet then there is high probability that the worker will be wet also and particularly receptive to electrical shock.

5.5.2 **Precautions - Before Starting Work**

Consider whether the work needs to be done while the area is wet. Consider the weather factors, e.g. Is it raining? Can process factors be changed?

The risk of this hazard may be reduced at this workplace by:

- The provision and maintenance of a residual current device at switchboard.
- Use of reduced or extra low voltage.
- The regular inspection, repair and testing of electrical leads and equipment
- Ensuring all leads are secured off the ground away from wet areas
- Taking measures to ensure that the worker is kept dry for the duration of the work
- Ensuring that the ingress protection of all the equipment is suitable for the task

This work will need to be formally risk assessed and if the mitigation doesn't reduce the risk to an acceptable level then the work should be postponed.

5.6 Guidance - Hazardous Areas

A Hazardous Area is defined as an area where a flammable atmosphere may be present over a range of time scales. Electrically we reduce risk of explosion by controlling potential ignition sources in a hazardous area. This is achieved by using certified Ex equipment in a hazardous area or by only using non certified equipment when there is no gas present in the Area.

When electrical work which requires the used of equipment which is considered to be an ignition source, a spark potential permit will be used with a gas detector. This is

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only acceptable for short time scales. Where equipment is to be located long term in a hazardous area, certified equipment will be used.

5.6.1 **Testing**

Any electrical testing, including testing for the presence of voltage in a Hazardous area, will require a spark potential permit and a gas detector.

5.6.2 **Use of Aluminium in Hazardous Area (E.g. Scaffolding Ladders Etc)**

Aluminium materials may not be use in hazardous areas due to the risk of incendive sparking when Iron oxide and aluminium strike each other. Only marine grade aluminium with low magnesium content may be used given that the equipment has been certified as safe to use in Hazardous areas.

5.6.3 **Repair Of Ex Equipment**

Repair of Ex equipment will be carried out by competent persons authorized to repair EX equipment to IEC 79-19 standard

5.6.4 **Comparison of IEC/ CENELEC/ NEC505 And NEC500 Certification**

Classification Area

	Continuous Hazard	Intermittent Hazard	Hazard under abnormal conditions
IEC/CE	Zone 0	Zone 1	Zone 2
NEC505	Zone 0	Zone 1	Zone 2
NEC500	Division 1	Division 1	Division 2

Gas Grouping

Typical Gas Hazard	IEC/CENELEC/ NEC505	NEC500
Propane	IIA	D
Ethylene	IIB	C
Hydrogen	IIC	B
Acetylene	IIC	A

Temperature Class

Max Temperature deg. C	IEC/CENELEC	NEC
450	T1	T1
300	T2	T2
280		T2A
260		T2B
230		T2C
215		T2D
200	T3	T3
180		T3A
165		T3B
160		T3C
135	T4	T4
120		T4A
100	T5	T5
85	T6	T6

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5.7 Guidance – Excavation Works and Electricity Cables

This guidance applies to situations where underground cables may be found and where work involves penetrating the ground at or below surface level. Buried services can be widespread and it should be assumed they are present unless it has been shown otherwise.

5.7.1 Hazards - Electricity cables

Damage to underground services can cause death or severe injury.

Injuries are usually caused by, the explosive effects of an arcing current, and any associated fire or flames, which may result when the live cable is penetrated by a sharp object such as the point of a tool. Such effects can also occur when a cable is crushed severely enough to cause internal contact between the conductors or between metallic sheathing and one or more conductors. Injuries are typically severe, potentially fatal, including burns to the hands, face and body. Direct electrical shock is less likely.

Incidents may also arise from damaged cables that have been left un-reported and un-repaired.

Other nearby services, such as plastic gas pipes, may also be at risk from damaged live electricity cables. This could result in explosions and greater fire risk.

5.7.2 Precautions - Before Starting Work

- Where available, make sure that you have the plans of the underground services in the area. This may not always be possible.
- Use cable locators to trace electricity cables (ensure that personnel are trained and competent to use the locator).
- Mark the positions of the cables using paint or other waterproof marking on the ground.
- Look for signs of cable connections (i.e. local equipment cables that go underground).
- Hand dig trial holes (as many as necessary to confirm the position of the cables in the area of your work). This is particularly important if there isn't an underground service plan or you haven't been able to locate cables indicated on the plan.

5.7.3 Precautions - During Work

- Wherever possible, hand dig near buried cables. Spades and shovels are safer than picks, metal rods, pins or forks.
- Check that any cable that is embedded in concrete and has to be broken out has been isolated and made dead before work starts, or that another safe way for working has been agreed with the cable owner.
- Watch out for signs of cables as work continues. Repeat checks with the cable locator as the excavation progresses.
- Back fill around cables with a fine material. Do NOT use flints, bricks, mass concrete or similar material.
- Report any damage to a cable. Even if there is no immediate danger, damage could cause danger at a later date. Do not attempt repairs.
- Do not use hand-held excavation power tools within 500mm of the marked position of an electricity cable.

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- Do not use hand held excavation power tools directly over the marked line of a cable unless:
    - You have already found the cable at the position by careful hand digging beneath the surface and it is at a safe depth (at least 300mm) below the bottom of the surface to be broken; or
    - Physical means have been used to prevent the tool striking it.
    - If an excavator is used near an electricity cable keep everyone clear of the bucket while it is digging.
    - Do not handle or attempt to alter the position of the exposed cable.

5.8 Guidance - Disconnection of Cables

5.8.1 Temporary Disconnection of Cables

Sometimes equipment needs to be removed for repair leaving the cable disconnected. Disconnected field conductors are to be shorted together, earthed and insulated or terminated into an appropriate Junction Box.

Where equipment is temporarily disconnected for a period of more than one shift then a reconnection permit (this is a permit taken out at the time of disconnection cross referenced on the ICC to ensure that the ICC isn't cancelled before the equipment is reconnected) will be raised and cross referenced to the Isolation Confirmation Certificate (ICC) for that circuit.

5.8.2 Permanent Disconnection of Cables

When equipment is permanently removed, its associated cables will be removed or suitably terminated for both the supply and the field equipment. Both ends of the cable are be earthed and terminated in a suitable junction box or abandonment kit. This type of disconnection is viewed as a change to the original design and will be subject to the normal Management of Change (MOC) process.

5.9 Guidance - Cable Cutting

No cable may be cut onsite after installation without positive means of identification. This may be achieved by use of a noose run along the cable from a disconnected end once the cable has had point-to-point confirmation of isolation and disconnection. Alternatively where cables have been buried an electromagnetic tone may be used with appropriate detection equipment to identify the cable where the cable is to be cut. However when this technique is used, the cable is to be spiked before cutting (this may cause the supply protection to trip in the event of mis-identification of a cable). After spiking, cable identification can be proved by testing at each end of the cable, as the phases will now be shorted and earthed (note for a multi-core instrument cable this may not happen completely, depending on the size of the spike). At no point may the cable be cut unless the cable identification has been proven.

Test procedure when cable spiking:

- When spiking the cable, the cable should be tested first 'phase to phase' and 'phase to earth' and the impedance values recorded.
- After the cable has been spiked, the cable will be retested 'phase to phase' and 'phase to earth' to confirm that all phases have been shorted to earth. Note: if the test values haven't changed from the pre-spike test then caution

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must be used as this may mean the incorrect cable has been spiked. The results should be reviewed and other possible circuits checked.

It is recommended that for cutting cables a hydraulic guillotine be used.

5.10 Guidance - Transformer Offload Tap-Changers

5.10.1 Hazards- Offload Tap-changers

Operation of an offload tap changer while the transformer is still on load is extremely hazardous. It will cause catastrophic failure of the tap changer, leading to injury or fatality of the person operating the equipment.

5.10.2 Precautions- Offload Tap-changers

- Operation of an offload tap changer may only be done under a permit to work when the transformer is isolated.
- To prevent unauthorised operation or tampering, all offload tap changers will be locked off or sealed.

5.11 Guidance - Overhead Power Lines

Overhead lines consist usually of bare (un-insulated) conductors (sometimes called cables) supported, via insulators, by wooden poles or metal or concrete towers and structures. Do not assume overhead lines on wooden poles are telephone wires. Overhead lines carry a range of voltages from 200V to 1050kV.

If work is to be carried out within 55m of an overhead line then this guidance should be used as part of the risk assessment process. This will also apply if access to a worksite involves crossing under an overhead line off-road.

5.11.1 Hazards - Overhead Power Lines

Contact with live overhead lines kills people and causes serious injuries every year.

If a crane jib, tipper lorry, excavator scaffold pole, ladder or similar object makes contact with or approaches near to these lines, an electric current can flow with a risk of fatal or severe shock and burns to any person in the immediate vicinity.

This can also occur with objects made from materials such as wood or plastic, which are normally regarded as electrical insulators. If damp or dirty, these may also be capable of transmitting sufficient current to cause dangerous or fatal electric shocks.

Note: Actual contact with a power line is not necessary to cause electric shock. A close approach to the line conductors may allow a 'flashover' or arc to occur. The risk of flashover increases as the line voltage increases.

5.11.1.1 Hazards - Overhead Power Lines & Induced Currents

Where metal or other conducting materials are being used close to overhead lines there is a risk of electromagnetic coupling. This effect is most severe when the conductor runs parallel to the overhead line. It is less pronounced when the conductor is perpendicular to the overhead line. To prevent the effects of this, the

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conducting material should be earthed at either end and, depending upon the length of the conductor, intermediate sections of the conductor should also be earthed.

This effect should be considered if any welding work needs to be done near or under overhead lines.

5.11.2 **Precautions - General Overhead Power Lines**

5.11.2.1 Pre Job Planning

First consider the following:

1. Find out if the work has to be carried out under or near overhead lines (within 55m). If possible, the work should be avoided.

If this is not possible then:

1. Obtain a map of the area and mark on it:
    - The route of the overhead line,
    - The work area,
    - Mark any access routes – highlighting any off road line crossings.
2. Identify the work to be done, highlighting:
    - The heights of the vehicles to be used (this should also include the length of telescopic arms, and any aerials used),
    - Lengths of pipe and scaffolding to be transported,
    - Steel ropes that could spring up if tensioned,
    - Height and type of any access platforms or ladders required,
    - If the work involves earth movements which could alter the ground topography under an overhead line,
    - Any welding that is to be carried out under overhead lines,
3. Consult with the owner of the over head line and establish the:
    - Line voltage rating (mark up the map with this information),
    - Line minimum ground safety distance for work (measured at ground level from the base of the tower/pole) (mark up the map with this information), If not know use 55m
    - Line minimum clearance height (head clearance) for road and access crossings (marked up the map with this information).

    Note: At no time is the height of the line to be measured directly; height can be calculated using a system of angles and ground measurement.

Note: This guidance does not quote clearance distances and ground safety distances, as these must be agreed with the owner of the line taking into consideration the voltage of the overhead line and the construction of the line towers or poles.

If access is required or work has to be done within the minimum ground safety distance then the following options should be discussed with the line owner:

- Divert all overhead lines clear of the work area or, if it is not reasonable for this to be done:
- Make lines dead and earth on both sides of the work site while the work is in progress (all lines are to be assumed live unless proven dead using an approved test method).

Note: This is to guard against energy being supplied on either side of the work location e.g. power sources and lightning strikes.

If it is not possible to divert or make the overhead lines dead, the work must be formally risk assessed with the overhead line owner and precautions agreed. Throughout the work, contact should be maintained with the overhead line owner,

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keeping the owner informed of the work progress and any changes to the work scope. Changes should be reviewed with the line owner and, if necessary, additional precautions considered.

5.11.2.2 Precautions - General

- Plan site toolbox talks to make all personnel working on the site aware of the hazards of working around overhead lines.
- No one should approach an overhead line without permission of the owner and the site manager/controller.
- No work at night without adequate illumination.
- Work under live overhead lines shall be suspended during thunderstorms or during weather when there could be lightning strikes. Arc striking distances increase during damp conditions and working under overhead lines in wet weather is to be avoided.

5.11.2.3 Precautions - Warning Signs

On approaching the overhead line to access the work site there is to be a warning notice posted in English, Russian and the local language stating:

Danger overhead lines
(Voltage of overhead line)
Minimum Clearance Height:
Instructions to drivers to secure jibs or loads
Speed limit

5.11.2.4 Precautions - Barriers

Barriers will be positioned parallel to the transmission line, either side of the approach, to mark the safe area for vehicles, other equipment and people to approach the worksite. The distance of the barrier from the overhead line will be agreed with the line owner but in no circumstance may it be less than 7m

Barriers should

- Be of stout construction that are difficult to move,
- Have high visibility,
- Be of sufficient height for drivers to see, giving due consideration to the types of vehicles being used on site. 6m high warning barriers should be considered where cranes etc are being used,
- Where barriers exceed 2m in height, the distance of the barrier from the overhead line should be no less than 14m (this is to allow for the possibility of the barrier being knocked over).
- Preferably made of non conduction materials

5.11.2.5 Precautions - Overhead Line Crossing Point

If access to the work site requires crossing under overhead lines off-road, then the following will be required:

- Location of crossing points should be agreed with the owner of the line,
- The number of such crossing points shall be kept to a minimum,
- The crossing points should be fenced to define its route, and goal posts erected at each end to act as gateways in the barriers running parallel to the overhead line,

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- Goal posts should be located a minimum of 14 metres either side of the line,
- The height of the goal posts should be agreed with the owner of the line,
- The goal posts should be constructed from rigid, non-conducting material such as suitable timber or plastic pipe and distinctively marked (e.g. with red and white stripes),
- At either side of the crossing points, on or near the goal posts, there should be warning notices giving the cross bar clearance height and instructing drivers to lower and secure jibs, tipper bodies etc and keep below this height while crossing,
- On sites where work continues after dark, the notices and crossbars should be lit. Illuminating of the conductors is also recommended. The light fittings used for this illumination should be sited at ground level projecting the light upwards towards the conductors.
- Additional warning notices and goal posts should be erected on the approaches to the crossing, of the order of 55 metres away.
- Consider the speed and stopping distances of the vehicles when positioning the goal posts. The position, should give the vehicle enough time to stop before reaching the line.
- The surface of the passageway should be levelled, firmed up and well maintained to prevent undue tilting or bouncing of the equipment when under the live overhead line.

Note: This preparation work should be risk assessed using the key points of this guideline

5.11.2.6 Specific Precautions for Equipment with Articulated Arms (e.g. Cranes, Diggers, etc) Working Near Overhead Lines

This type of work will need to be risk assessed with the owner/operator of the overhead line considering all of the factors for work near overhead lines.

- All overhead lines shall be assumed to be live, unless positively isolated and grounded at both sides of the location of the work.
- A safe clearance distance shall be maintained at all times between the articulated arm, its load and the overhead line (this distance to be agreed with the overhead line owner/ operator). If it is necessary to work within the safe clearance distance, work is to be deferred until the overhead line can be de-energized.
- Where a vehicle with an articulated arm is working near an overhead line, a banksman shall be posted. His function is to warn the vehicle operator if the safe clearance distance is going to be breached. This person should not stand next to the vehicle, and communication with the operator will be achieved by radio. The safe distance for the signalman will depend on the voltage level of the line. This safe distance should be agreed with the line owner before work commences.
- If an articulated arm cannot extend or reach into the safe clearance zone then the need to post a signalman may be waived following a site inspection.
- When working near an overhead line, the vehicle and articulated arm should be operated at slower speeds than normal.
- Be aware when working near mid or long spans that the wind may make the lines sway and reduce clearances.
- When the vehicle is working near an overhead line all personnel shall stay away from the vehicle and its articulated arm and its load until the banksman says it is safe to approach.

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In the event that the vehicle with the articulated arm or its load makes contact with an overhead line the following actions shall be taken:

- If electrical contact is made, stay in the vehicle or mobile equipment if it is safe to do so. You are relatively safe inside your vehicle if you do not touch or step onto anything outside the vehicle that will provide a path for the current to flow to ground. Wait until the owner of the power system has verified that the power lines have been de-energized and earthed.
- All personnel should keep well away from the vehicle and its articulated arm because the vehicle and the ground around the machine may be energised, the tyres may explode or the line may collapse. If you are close to the vehicle, it is safest to shuffle away without moving your feet more than a few centimetres at a time. Keeping your feet together will ensure that you do not straddle two zones with different voltages.
- If the vehicle is not damaged and is not entangled with the power line, it is safe to slowly drive out of the energized area to at least 55 metres clear of the wires and any wet ground. Because of the danger of exploding tyres, large mobile equipment with inflated rubber tyres should be moved to an open space away from workers and other equipment. There is a danger of exploding tyres for up to 24 hours.
- If you must abandon your vehicle because of an emergency such as a fire, be aware of the possibility that the ground below your machine is energized and use extreme caution. To make a safe escape, keep both feet together and hands by your side and make a short jump from your vehicle. The goal is to ensure that your body clears the vehicle and that you land on your feet without stumbling. Do not allow any part of your body to touch the vehicle while you are touching the ground.
- Do not take steps away from the vehicle. It is safest to shuffle away without moving your feet more than a few centimetres at a time. Keeping your feet together will ensure that you do not straddle two zones with different voltages.
- Do not return to the vehicle or the line until the line has been isolated, proven dead and grounded.

Note: mobile equipment involved in an incident with a power line must be fully inspected and, if necessary, re-certified before being used again.

5.11.2.7 Specific Precautions for Rescue Work Around Power Lines

The main role for rescue workers near downed power lines or energized equipment is to stop people from getting hurt. Here are some safe work practices:

- Treat downed lines and anything in contact with a power line as energized. Energized wires seldom leap about and give off sparks, so you have no way of knowing whether or not they are energized. Even if the line is not energized, automatic switching equipment may restore power to the line without warning.
- Park well clear. When you arrive at the scene, park your vehicle well away from any downed lines. At night, shine a flashlight though the window to make sure that you are not parked anywhere near a downed power line.
- Stop traffic and keep people clear. Workers on foot or in vehicles may not see lines that are lying on the ground. The ground surrounding a downed line may be energized. If a live wire comes in contact with a vehicle, or anything else, that object becomes energized. Secure the area and keep everyone back at least 55 metres.
- Do not let yourself become a victim. Regardless of how badly someone is injured, you cannot help if you are electrocuted. Never touch anything that is in contact with a downed power line, including injured or trapped victims,

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puddles, vehicles, or trees. Do not use a dry stick or piece of rope or hose, as they will not offer any protection. Do not enter an area that might be energized.

- Call the central control and the owner of the power line. Identify the location of downed power lines and await assistance.
- Only accept confirmation that the system has been de energized and is safe, from a representative of the power line owner who is on site and has earthed the line on site.

5.12 Guidance - Pole Mounted Switchgear

This section gives general guidance on the operation of pole-mounted switchgear but sites will be required to have specific detailed procedures covering their installation.

General Precautions

- Consider weather conditions - wet weather and wind loading affects safe working.
- Visually Inspect Equipment - verify the equipment shows no physical signs of damage.
- This work is to be accompanied.

Personal protective equipment

- **I**nsulated footwear is to be worn.
- Appropriate flash apparel to be worn (as appropriate to the equipment).
- Insulated gloves of the correct rating to be worn.

Operation

- Check that all downstream circuits have been disconnected and isolated.
- Look away from the point of disconnection.
- In a smooth continuous manner open the disconnector. In no circumstances should the operation be interrupted prior to the complete opening of the disconnector. (During the operation an arc will be drawn and this will affect the life of the contacts).

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5.13 Guidance -Station Batteries

Batteries may be:
Acidic or alkaline in design:
SEALED BATTERIES without any requirement for liquid top up.
WET CELL BATTERIES that require periodic liquid top up.

5.13.1 **Hazards- Batteries**

The misuse of batteries, through not heeding precautions, may lead to the leakage, heating or bursting of battery casings and could cause serious injury to personnel.

Serious injuries, which may occur when handling batteries, would include:

- Loss of eyesight
- Burns
- Electrical shocks
- Bone fractures
- Poisoning

Minor injury includes:

- Slight burns
- Electrical shock

Access to battery systems is to be controlled to those persons who are competent and can recognize danger.

5.13.2 **Precautions - All Battery Systems**

Personnel protective measures to be considered:

- Do not wear any jewellery or exposed metal when working on batteries. Ensure that all pockets are empty to prevent items falling on to batteries whilst working.
- Always wear eye protection (safety glasses for sealed batteries and visors for wet cell batteries).
- When the battery voltage exceeds 120V use insulated gloves (ensure that impairment to dexterity is considered when using this precaution). Where practical, split the battery into lower voltage sections (typically lower than 120 volts) before commencing work.
- If handling batteries a inspection is to be carried out prior to commencing work to ensure that there is no signs of leakage. If there is additional PPE will be required
- If the battery contents come into contact with the skin or clothing, immediately remove the affected clothing and wash skin with plenty of clean water. Any contact with the eyes should be immediately flushed with plenty of clean water. Seek medical advice.
- Batteries should have an eye wash station located within the area.

Work on a battery is considered to be live work, which will need a method statement and a risk assessment:

- Batteries are heavy: manual-handling assessment to be completed before moving batteries.
- Personnel working on battery systems are to be accompanied.
- Always turn the charger off before disconnecting the battery.

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- Disconnect battery from charger and load before commencing any work on a battery. Breaking live circuits at the terminals of a battery will cause sparks to occur.
- Always use insulated tools. Un-insulated tools may cause a short circuit, and the heat or sparks generated by the short circuit could result in burns, damage to the battery, or ignite a gaseous atmosphere. All insulated tools to be marked with voltage rating and this should be greater than the highest voltage expected (min 500V)
- Do not mix tools for flooded alkaline and flooded acid battery types.
- When cleaning batteries, use a soft brush. Never use a dry cloth, as this will cause static electricity, leading to possible ignition and bursting of the battery.

Battery operation:

- Avoid over or under charging.
- Charge batteries between the temperatures of $0^{o}C$ and $45^{o}C$ using appropriate temperature compensation to prevent over or under charging. Over charging could lead to thermal runaway.
- Avoid boost charging of sealed batteries, as this can cause battery failure and a high level of gas production (hydrogen).
- Batteries should be disconnected from the load before deep discharge occurs.
- Keep sufficient space between batteries for ventilation (10mm is recommended).
- Install batteries in a cool and well-ventilated place.
- Position batteries securely, protecting them from abnormal shocks or vibration.

Battery storage for batteries not in use

- Avoid storing batteries in dusty environments as this may lead to battery shorting.
- Battery storage should be temperature controlled to maintain a temperature of 25oC.
- Recharge the batteries at least every 6 months during storage.
- Batteries are to be stored in a fully charged state.
- Avoid placing batteries next to a heat source as this may cause the battery to overheat, leak, ignite or burst.

Battery Don’ts

- Do not use batteries of different types in the same battery bank.
- Do not use damaged or deformed batteries.
- Do not solder leads directly to the battery.
- Do not over torque battery connections. Consult manufactures guidance to establish torque value.
- Do not press and / or bend the terminals, or overheat them.
- Do not short circuit battery terminals in normal operation as this could lead to an explosion.
- Never incinerate batteries as they may explode. Use approved waste disposal routes only.
- Never disassemble the battery casing.
- Never charge a battery in a sealed container as this may cause explosion of the equipment or injury.
- Never obstruct the battery gas vent.

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5.13.3 **Precautions - Unsealed Wet Battery Systems**

- Unsealed wet batteries to be kept in a separated battery room, with independent ventilation, if the volume of produced hydrogen presents a risk.
- Where the volume of hydrogen presents a risk, all electrical equipment within the battery room shall be suitable for operation in a flammable hydrogen environment. Appropriate gas detection should also be in the room, which should give an alarm to a central control position.
- Non-conducting non-slip slatted flooring is to be used to prevent slipping and avoid pools of acid in the event of leakage.
- Before commencing any work a hydrogen gas check is to be performed
- Personnel to wear chemical resistant Personnel Protective Equipment (PPE) appropriate to task

Task – Unsealed cell	**Protective clothing**
Cell voltage test	Overalls and goggles
Electrolyte level checking	Apron, PVC gloves and Visor
Electrolyte replacement	Goggles heavy duty PVC "green" overalls and PVC gloves

- Personnel must be specifically trained for topping up of wet cells.
- A suitable neutralising agent to be on site when handling electrolyte (e.g. soda solution 5% for acid).

5.13.4 **Battery Disposal**

Batteries will be disposed of using an approved route.

Note; The battery maintenance contractor has access to approved disposal facilities and should be the primary route for disposal.

5.14 Guidance - Instrument Protective Systems

Special precautions must be taken when working on systems whose function is to protect people, plant, the environment and continuity of production against excursions outside plant design envelopes.
Such systems include:

- Shutdown or Emergency Shutdown (ESD) systems
- Fire and Gas systems.

The following precautions must be observed when working on instrument protective systems:

- Application of inhibits and overrides shall be controlled and recorded. Particular attention shall be paid to the consequences of multiple applications of overrides.
- All instrument protective systems shall have appropriate test and maintenance programs designed and implemented to maintain the required safety integrity of the systems.
- When protective systems or parts of systems are taken out of service, suitable compensating measures shall be implemented to maintain the safety of the plant.

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To avoid damage from electrostatic discharge when working on sensitive electronic circuits, the need for earthed wrist straps should be considered. Handling and packaging of electronic circuit board operations should also guard against the risk of damage from electrostatic discharge.

5.15 Guidance - Electrical Test Equipment

Electrical Test Equipment will be chosen so that it is suitable for the voltage and current duties required this will include the requirements over voltage protection as identified in EN61010 as it applies to low voltage test equipment.

Within the Azerbaijan Strategic Performance Unit all low voltage test equipment is required have a minimum over voltage protection category of III which has been verified by an independent test house (i.e. UL, BDE TUV etc)

i.e. 1000V CAT III

> **NOTE:** These requirements also apply to all test leads being used which should be marked with the voltage and the category ratings

The electrical safety of the test equipment must be maintained to prevent injury to personnel:

- The safety of portable test equipment should be confirmed at 12-month intervals.
- Test equipment, should be visually inspected for damage by the user before use.

The accuracy of the test equipment is important when making decisions when fault finding and proving dead:

- Test equipment should be calibrated to meet the manufacturer's recommendations; normally every one or two years period to be determined by the site responsible electrical person based on use.

5.16 Guidance - Telecommunications

5.16.1 Radio Equipment Hazards

The use of radio equipment on petro-chemical installations leads to a number of potentially hazardous situations. These are:

- Certification limitations
- RF induced ignition hazards
- Premature detonation of EEDs. (Electro-explosive devices)

5.16.2 Certification Limitations

Communications and navigation equipment shall normally be sited in non-hazardous areas.

Where equipment has to be located or used in a hazardous area, and certified equipment is not available, then the following special protection measures shall be employed to avoid an ignition source:

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- The power supplies of unprotected telecommunications equipment shall be isolated if hydrocarbons are detected in the relevant equipment areas (examples include NDB's (Non Directional Beacon) and temporary navigational beacons).
- In the event of a hydrocarbon release, or a potential release, then radio and radar transmissions shall automatically be reduced to less than two watts, or automatically switched off (examples include line of sight radio links, satcom terminals, private mobile radio).
- All hand-portable radios, paging units and fitted accessories shall be certified as conforming to European Committee for Electro technical Standardisation (CENELEC) (not Factory Mutual) intrinsic safety standards.
- Personal entertainment items, permanent or temporary radio beacons, or transponders shall be confined to accommodation areas, or must be operated under the Safe System of Work.
- Mobile telephones are not permitted on any plant areas where hydrocarbons are processed or handled.

5.16.3 **Radio Frequency Induced Ignition Hazards**

Radio Frequency Induced Ignition Hazards can exist where radiation induces sufficient energy in a suitable receiving structure to generate an incentive spark in an area containing a gas-air mixture. It is feasible for a hazardous area to be at risk from transmissions originating outside that area.

Such hazards depend on the specific radio and geographical circumstances of each installation. Therefore, a radio survey is normally undertaken of each installation, hazardous and non-hazardous areas are calculated, and guidance notes prepared. Surveys can be undertaken with reference to BS 6656.

5.16.4 **Premature Detonation of Electro- Explosive Devices (EEDS)**

The operational limitations placed upon the use of radio and radar transmissions are dependent upon the type of EED being used as categorised below:

- For wire line and perforation operations where the Schlumberger SAFE, Saltus 45 Omega Intelligent trigger, or PES Electronic timer systems are used, there are no restrictions on transmissions, except for the use of hand portable radios within 5 metres of the point at which the devices are being armed, or 5 metres of the device once armed.

These safe trigger systems have been formally assessed and further devices may be added after review.

- For conventional wire line EEDS and other devices not identified in above, the site-specific radio silence procedures, including vessels and installations in the vicinity, are to be implemented. (These are based on the radio surveys described above in Radio Frequency Induced Hazards.)

These procedures will normally allow radio transmissions except MF / HF, NDB's and portable radio use in the immediate vicinity of the wire line operation.

5.16.5 **Technical Precautions**

The following precautions apply:

5.16.5.1 Antennas and Masts

Safety signs should be displayed warning of radiation and access hazards, and protective rails should be provided, at antenna and satcom. terminal sites.

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Where work is undertaken on antennas, satellite antennas or masts, reference should be made to the Safe system of work in respect of isolation, safety equipment and adjacent operations.

5.16.5.2 Radio and Telecommunications Equipment Rooms

- Access to radio rooms and telecommunications equipment rooms should be restricted to the relevant authorized personnel.
- Warning signs should be located in telecommunications equipment rooms regarding handling of electrostatic sensitive devices and toxic electronic components.

5.16.6 **Telecommunications Test Equipment**

- The safety of portable test equipment should be confirmed at appropriate intervals.
- Test equipment should be calibrated to meet the manufacturer's recommendations; normally every one or two years.
- Where entry into a sealed unit will invalidate EX certified telecommunication equipment's certification, repair or modification must be undertaken by the manufacturer's approved agent.

Note: Persons who have successfully completed a Comp'Ex or equivalent assessed course can install and perform routine maintenance normally limited to installation, inspection and test without breaking the manufacturer's seals. However, if the manufacturer's seals are broken all work must be undertaken by the manufacturer's approved agent.

- In certain circumstances, e.g., for troposcatter installations, separate radio frequency earthing must be provided and maintained.
- Reference should be made to local Waste Management procedures, regarding the disposal and handling of beryllium, cyanide or mercury based electronic components. Manufacturer's manuals should be consulted regarding such components.

5.16.7 **Biological Hazards and Precautions**

The National Radiological Protection Board (NRPB) recommends that the whole-body Specific Absorption Rate is limited to 0.4 W / kg averaged over any 15 minute period.

From these recommendations, radio radiation on a facility does not give undue cause for concern if the normal antenna site access and warning precautions described in the Technical Precautions are implemented, and the following restrictions are considered:

- No person should undergo prolonged (e.g. over 1 hour per month) exposure within 5 metres of omni directional aerials connected to transmitters radiating in excess of 25 watts
- Only radio competent persons, or persons working under their direct supervision, are permitted within the restricted zones following appropriate safety procedures to limit the duration and amount of exposure
- No person shall be able to enter the main beam of (high direction) satellite, troposcatter, line of sight, or similar radio transmissions.

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Hand-portable radios must be treated with respect so that excessive numbers of transmissions are not undertaken with the antenna close to the head and eyes.

5.17 Guidance - Temporary Earths

Temporary earth facilities will primarily be used on HV systems where no circuit earthing is provided at the switchgear or where personnel feel a need for additional earthing at the work site.

Verify that the circuit is DEAD and has been tested by means of a voltage indicator, itself being tested on a proprietary test unit, immediately before and after use.

Where facilities exist, earthing should be effected via an earthing circuit breaker and operated in the manner prescribed in the manufacturer's instruction manual.

When using a portable earthing device, the device shall consist of an insulated conductor of not less than 70 sq mm copper, (The size being related to the probable short circuit current). If the probable short circuit current warrants it, smaller conductors may be used. However, the conductor must always be equal to or greater than the size of the phase conductor. The earthing lead shall be securely connected to the main earth, and the free end to an insulated rod.

The procedure for using a portable earthing device is as follows:

- Attach the earthing lead to earth
- Apply the earthing lead to each phase, by means of the insulated rod, so that each conductor of the apparatus is discharged one at a time and then shorted collectively.
- After the apparatus has been discharged, and whilst the discharging lead is still in position, earthing bonds, of similar cross section to the portable earthing device, must be secured.
- Where the apparatus to be worked on can be fed from more that one source, an earth bond must be attached on each side of the apparatus.
- When disconnecting a portable earthing device, the connections must be removed from the phase conductors first and the earthing connection last.

Where the discharge of residual energy is carried out using a proprietary insulated rod incorporating a resistor, and that has a trailing lead that is not normally fitted with 70 sq mm cables, it is acceptable.

5.18 Guidance - Temporary Lighting

All temporary lighting bulbs or tubes should have protection to protect the bulb or tube from breakage

5.18.1 Temporary Lighting On Main Plant

For hydrocarbon plants, temporary lighting will be suitable for use in Zone 1. (Temporary lighting may be installed in various locations so, to avoid non-certified lighting being installed in hazardous areas, the standard of lighting to be used is standardized at Zone 1).

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If cabling is properly installed and the lighting is fixed, the circuit may be 110V fed from a centre tapped 110 V earthed transformer, backed up with 110V 30mA RCD protection.

Where temporary lighting is used, consideration must be given to safe egress in the event of main lighting failure. This can be addressed by using battery backed light fittings, portable battery backed lighting or torches. However, batteries must be monitored and recharged as appropriate.

Where personnel are using trailing leads, the lighting will be 25V or less with double insulated construction. Flexible cables are to be protected against inadvertent damage or of damage resistant construction (e.g. braided cabling or cable protected by heavy rubber sheathing).

Battery lamps (torches) may be used but should be certified for Zone 1 use.

5.18.2 Temporary Lighting In Confined Spaces

Use of electrical lighting in confined spaces of all shapes and sizes must consider the following risks:

- Risk of Hydrocarbons.
- Risk to personnel due to close contact with electrical equipment.

The following measures reduce these risks:

- Electric lighting may not be used until the space has been declared gas free.
- Once the space has been declared gas free then Zone 1 lighting may be used.
- Where the space is small, and personnel come in close contact with the electrical installation, then the equipment voltage levels will be kept below 25V if possible, double insulated fittings to be used and, if earthed, a 30mA RCD will be used.
- If the space is large and lighting and cabling can be properly installed away from personnel, 110V Zone 1 lighting can be used, fed from a centre tapped 110 V earthed transformer, backed up with 110V 30mA RCD protection.

Where temporary lighting is used, consideration must be given to safe egress in the event of main lighting failure. This can be addressed by using battery backed light fittings, portable battery backed lighting or torches. However, batteries must be monitored and recharged as appropriate.

5.19 Guidance - Temporary Power Distribution

Occasionally temporary power distribution will be required on site for purposes of construction or repairs. Any such distribution will be properly designed and constructed. The following is guidance for such distribution:

- As a minimum: load lists and single line diagrams are required for any temporary distribution and these will be available on site. Equipment will be identified for the purposes of inspection records and to ensure equipment is correctly identified for purposes of isolation.
- Where possible temporary distribution for portable tools will be limited to 110V centre tapped to earth (i.e. Restricted Low Voltage - the shock voltage to earth under fault condition is restricted to 55V).

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- Temporary power distribution will not be located in hazardous areas unless appropriately certified for the location, or appropriate risk assessments have been carried out.
- Appropriate protection will protect the incoming and outgoing circuits of any temporary distribution. It is desirable that this protection incorporates a 30mA RCD for each outgoing circuit.
- All circuits to incorporate lockable isolation points.
- Temporary Equipment should have a minimum ingress protection of IP54 (given that this equipment is often installed outside).
- Designed voltage drop at the distribution board should not be more than 4%, unless other wise determined as acceptable.
- GOC will be used to record installation and commissioning tests.
- In no circumstance is plant or site metal work to be used as a return path, e.g. welding sets are to be earth bonded the work piece is earth bonded and each welding point has its own return to its welding set.
- The design will consider if a fire and gas or emergency shutdown is required for temporary distribution.

5.19.1 Temporary Distribution - Cables

- All temporary cables within hazardous areas shall be high visibility, fire retardant type; above 110V they shall be Armour braided or double insulated.
- Cables will be appropriately managed using tray or temporary hooks.
- Any joint in cables will be properly constructed with an approved jointing method.
- Cables to be sized using BS7671 guidance.
- Cables to incorporate an earth wire with the phase conductors; or a separate earthing conductor to be installed and connected to the site earthing system.
- Cables, which are to be used on portable equipment, should be damage resistant and protected with flexible braid or heavy rubber sheathing.
- Temporary cabling is to be clearly identified.

5.19.2 Temporary Distribution - Generators

Where power supplies or temporary generation is connected into the site power system this should be engineered and managed through the Management of Change (MOC) process.

Islanded generators, which supply temporary distribution, will be site earthed to the main site earth.

5.19.2.1 Requirements for Diesel Engines Offshore In Non-Hazardous Areas

5.19.2.1.1 Spark Arrest

An efficient dry cyclone, baffle type or water bath gas conditioner box type shall be fitted downstream of the exhaust manifold and shall be fully maintained according to the supplier's recommendations.

5.19.2.1.2 Air Filter

An efficient air filter shall be fitted to the air intake and fully maintained according to the supplier's recommendation.

5.19.2.1.3 Over-Running Shutdown

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Engines above 10 KW:

- A device shall be provided that will automatically stop the engine if it over-speeds above the governed speed. Additionally, a manual operation shall be provided (Note: The intention is to provide a safeguard in the event of the engine drawing volatile vapour into the air intake causing the engine to race and continue operating after the normal fuel supply has been closed off). The following are methods of operation:
    - Close off the air intake by means of a valve, provided the device is either supplied by the engine manufacturer or approved by him as non-harming to the engine.
    - "Smother" the engine by injecting inert gas into the air intake, provided the engine manufacturer approves it, with particular consideration being given to thermal shock.
    - Render the engine incapable of firing by the use of decompressing systems (e.g. valve lifters or special decompressing valves). These devices are usually standard equipment on all large engines and many small engines**.**

Engines below 10 KW

- As above except that manual operation only need be fitted.

5.19.2.1.4 Hot Exhaust Surfaces

Any exhaust manifold or exhaust pipe surface that may reach a temperature of above 250°C will be insulated with fibreglass lagging and aluminium or steel cladding.

5.19.2.1.5 Belts

All driving belts will be of an anti-static material.

5.19.2.1.6 Shut down systems

All shutdown systems will have

- Emergency stop button.

In addition there may also be a site requirement for

- Volt free trip contacts that can be connected to the site shutdown systems.
- Gas detection leading to auto shutdown.

5.19.2.2 Hazardous Area Duty

When a generator is to be installed into a hazardous area then the normal hazardous area rules will apply.

1. Hazardous Area Diesel Engine in accordance with BS EN 1834-1, “Reciprocation internal combustion engines construction of engines for use in potentially explosive atmospheres part 1 Group II engines for use in flammable gas or vapour atmospheres”.

Note: If the engine is shut down due to gas detection then the engine may not be restarted until the engine has been fully check for gas ingress

Temporary Distribution – Inspection

Equipment Application	Voltage	User check	Recorded visual inspection	Recorded inspection and test
25v portable hand	25V secondary	Prior to	No	Yearly

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lamps (confined or damp situations)	winding from transformer	use		
110V portable and handheld tools, extension leads, yard lighting, moveable wiring systems and associated switchgear	Secondary winding centre tapped earth (55V)	Weekly	Monthly	3 monthly or when initially used on a new site
230v Portable and handheld tools, flood lighting and extension leads (Should be used by exception only)	240V mains supply through 30 mA RCD	Daily /Every shift	Weekly	Monthly or when initially used on a new site
230V fixed (non moveable) equipment	240V Supply fuses or MCBs	Weekly	Monthly	3 monthly or when initially used on a new site
RCD's		Daily /Every shift: manual trip of RCD	Weekly	3 monthly or when initially used on a new site
Steam/ water pressure cleaners		Weekly	Monthly	3 monthly or when initially used on a new site
Other portable or temporary equipment		Daily /Every shift	Weekly	Monthly or when initially used on a new site

Typical Testing:

- Visual inspection for defects.
- Continuity for protective conductors.
- Insulation resistance.
- Site applied insulation.
- Earth fault loop impedance test for earth continuity, (this test will not be done on live hydrocarbon plants).
- Polarity.
- Proof testing of residual current devices, whenever appropriate.
- Inspect for cable damage, note cables may be repaired with proper cable repair kits

Records of inspection and testing will be held in a central location on site with the temporary distribution load list and single line diagram.

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5.20 Guidance - Rubber Gloves

Rubber gloves for electrical purposes shall conform to BS IEC 61942:1997 or BS60903. And should be worn in conjunction with an over glove

Live working is not a normal activity on site and is only done by exception therefore the use of rubber gloves is not a normal precaution required on site.

Each site should have access to rubber gloves of an appropriate voltage suitable for working on their systems. Unmanned sites will not have insulated gloves permanently located. However, these will be taken to the site in a suitable container, while work is ongoing.

5.20.1.1 Gloves shall be marked as follows:-

Suitable for live working; double triangle
Standard Number and Year
Name, trademark or identification of the manufacturer
Category (if applicable)
Size
Class
Serial number or batch number
Month and year of manufacture
Last test date

Designation of maximum use voltage

Class	**Colour**	**AC** **V r.m.s.**	**DC** **V**
00	Beige	500	750
0	Red	1 000	1 500
1	White	7 500	11 250
2	Yellow	17 000	25 500
3	Green	26 000	39 750
4	Orange	36 000	54 000

Special properties

Category	**Resistant to**
A	Acid
H	Oil
Z	Ozone
R	Acid, oil, ozone
C	Extremely low temperature

In-service recommendations

The following is guidance, for the maintenance, inspection, retest and use of gloves after purchase.

5.20.1.2 Storage

Gloves should be stored in their original container or package. Care should be taken to ensure that gloves are not compressed, folded, or stored in proximity to steam

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pipes, radiators or other sources of artificial heat or exposed to direct sunlight, artificial light or other sources of ozone. It is desirable that the ambient temperature be between 10oC and 21oC.

5.20.1.3 Examination before use

Each time before use, both gloves of a pair should be visually inspected and subjected to a manually applied air test, where practicable. If either glove is thought to be unsafe, the pair should not be used and should be returned for testing.

5.20.1.4 Temperature

Standard gloves (Category A, H, Z, R) should be used in areas having ambient temperatures between –25oC and +55oC. Category C gloves can be used in ambient temperature between –40oC and +55oC.

5.20.1.5 Precautions in use

Gloves should not be exposed unnecessarily to heat or light, or be allowed to come in contact with oil, grease, turpentine, white spirit or strong acid.

Protector gloves are worn over rubber insulating gloves, they should be sized and shaped so that the insulating glove will not be deformed from its natural shape. The minimum distances between the cuff of the protector glove and the top of the cuff of the insulating glove should not be less than that specified below

Class	**Minimum distance mm**
00, 0	13
1	25
2	51
3	76
4	102
Note: distance should be increased by 25mm for class 3 and 4 products used on d.c. systems *Note: the insulating glove is the longer glove*	

Protector gloves that have been used for any other purpose should not be used to protect insulating gloves. Protector gloves should not be used if they have holes, tears or other defects that affect their ability to give mechanical protection to the insulating glove. Care should be exercised to keep the protector glove free from any contamination that may damage the insulating glove. Contaminated protector gloves should not be used unless they have been thoroughly cleaned of the contaminating substance. The inner surface of the protector gloves should be inspected for sharp or pointed objects; this inspection should be made at the same time as the insulating gloves are inspected.

When gloves become soiled, they should be washed with soap and water at a temperature not exceeding that recommended by the glove manufacturer, and then thoroughly dried. If insulating compounds such as tar and paint continue to stick to the glove, the affected parts should be wiped immediately with a suitable solvent, avoiding excessive solvent use, and then immediately washed and dried as described above.

Gloves which become wet in use or by washing shall be dried thoroughly, but not in a manner that will cause the temperature of the gloves to exceed 65oC.

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5.20.1.6 Periodic inspection and electrical re testing

No gloves of classes 1, 2, 3, and 4, not even those held in storage, should be used unless they have been tested within a maximum period of six months. The most common periods currently range from 30 days to 90 days

The tests consist of air inflation to check for air leaks, a visual inspection while pressurized and then a routine dielectric test in accordance with the IEC or EN BS standard.

For class 00 and class 0 gloves, a check for air leaks and a visual inspection may be considered adequate. However, a routine dielectric test may be performed.

For lined gloves, the test should be carried out by means of an appropriate tester to make sure that the gloves are not defective.

5.20.1.7 Gloves for general electrical work

General Work gloves should be non conductive leather or nomex, this increase contact impedance as well as giving some protection against heat or other injury

5.21 Guidance - Switchrooms and Switchyards

This guideline covers general requirements for electrical switchrooms and switchyards.

5.21.1 Hazards - Switchrooms and Switchyards

Electrical switchrooms and switchyards house a range of electrical equipment i.e. switchgear, battery systems and control cabinets. These systems operate over a range of voltages, currents and fault levels and all are capable of giving rise to danger if mal-operation was to occur.

5.21.2 Precautions - Control of Access To Switchrooms And Switchyards

Access points to switchrooms or switchyards should be clearly identified with a suitable warning notice stating; “Restricted Access, Authorized Personnel Only”.

Access to electrical Switchrooms is to be controlled. Locking the switchroom and restricting access to authorised personnel, personnel under their direct and continuous supervision, or those personnel working under an approved Permit To Work, will normally achieve this. Any person working within a switchroom must be made aware of any hazards within that room and what precautions need to be taken to avoid danger.

No person may work alone within a switchroom or yard, where there are exposed live conductors that persons could come into contact with and cause injury. Access to these areas is to be controlled at all times and an authorized person must supervise work.

Note: Offshore locations where switchrooms act as an escape route. The switchroom maybe left unlocked, however the escape route must be clearly identified. As part of the offshore induction process, all personnel must be made

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aware of any hazards within that room and what precautions need to be taken to avoid danger.

Note: where equipment is mounted on transmission poles, it is considered to be part of the overhead lines system and the overhead line guidance will apply.

5.21.3 Precautions - Within Switchrooms and Switchyards

The immediate area around all switchboards and equipment racks must be kept clear of all obstructions: the recommended minimum distance is 0.75m. This is to allow good working access to equipment, without risk of tripping hazards and to ensure adequate ventilation to the equipment.

The switchrooms will be provided with adequate lighting for work activity, this will include permanent or temporary 'emergency lighting', to provide light for 'making safe' and 'exiting', in the event of a lighting failure.

Note: loss of lighting while working can lead to injury, i.e. trips and falls and any hazards associated with work adjacent to live equipment.

If a switchroom is large, a clearly identified 'controlled area' may be used for storing non-hazardous/ non-flammable equipment.

Generally switchrooms are not seen as permanently manned areas and using them as offices etc is not encouraged. This is due to the high energy levels that equipment in these rooms must deal with in the event of an electrical fault. Some hazards associated with high energy levels, are excessive noise, heat and electrical arcing. If a switch room is to be permanently manned, this decision should be formally risk assessed.

Depending on size, a switchroom will have two means of access and egress, allowing personnel to avoid danger when exiting or entering the area.

Each main switchroom shall display a single line diagram of the main electrical distribution. Detailing fault levels, voltage and current ratings of the main distribution components (i.e. switchboard and transformers.)

Each main switchroom shall display a poster covering emergency resuscitation.

Equipment to be available within switchrooms will include but not limited to:

- Insulated matting of an appropriate voltage rating will be provided around electrical switchboards, to reduce the effects of electrical shock (this is required as footwear worn on a hydrocarbon plant is conductive to prevent static build up)
- Insulated Shepherd's crook of an appropriate voltage rating for working on the system (to provide an insulated method of pulling personnel away from electrical equipment).
- Non-conducting stepladders or access platforms (as it is common for displays on switchgear to be above head height a suitable insulated access platform is required).
- Each site should have access to electric gloves of an appropriate voltage suitable for working on the systems. A range of sizes is to be provided with the appropriate over protector gloves. A suitable container to store the gloves.
- First aid station with suitable burns dressing.

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- Eye wash station - for irrigation of eyes after an arcing incident, etc.
- Suitable test and proving equipment to prove equipment dead.
- Suitable grounding and discharge equipment.
- Specialist PPE if required. (Full face visor, Nomex gloves, Nomex jacket and insulated boots for working in switchyards on overhead switchgear).
- CO2 or dry powder fire extinguishers.
- Switchroom logbook. (available online using **Reprographics HSE request form)**
- Smoke detection. (For early detection of problems).

Unmanned sites will not have insulated gloves, eyewash and first aid kits permanently located, however these will be taken to the site in a suitable container while work is ongoing.

Depending on work activity the following items may also be required

- Insulated barriers or screens.
- Insulated tools.
- Barriers (suitable for controlling a work area).
- Various Warning Signs (Danger Notices, Caution Notices, etc)

5.22 Guidance - Static Electricity

Complete explanations of static electricity are complicated but the following will provide a background against which the pattern of precautions to be observed can be better appreciated.

5.22.1 Generation of Electrostatic Charges by Contact and Separation

By contact and separation
There are a number of ways in which a 'substance' - liquid, metal, gas containing solid particles or droplets, nylon clothing and people themselves - can acquire a static charge, but one of the main concerns is contact electrification. Contact electrification occurs if two dissimilar materials in contact are separated - one acquires a negative charge, the other an equal positive charge.

When pumping through a pipeline, the two dissimilar materials being separated are the product and the metal pipeline. If the product being pumped is black oil, then both materials are good conductors and the charges will dissipate or relax as quickly as they are formed. They will not build up to dangerous potentials where arcing can occur.

If one or both substances is a non-conductor or a relatively poor conductor (for example, gasoline) the charges, or part of the charges, will be retained by the gasoline and may persist for some time.

The magnitude of the charge, and the amount of energy evolved, depends upon the speed of separation (e.g. the rate of flow of the product through the pipe). The greater the speed, the greater the static charge. The potential difference involved in static generation can be several thousand volts.

By induction
Charges can be induced into an object that is in an electric field, e.g. a loose gauge float or sample can floating on the electrically charged surface of the product. This object can become charged and arc to the tank frame.

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Charge can also be induced into conducting material that is insulated from the general body of earth (e.g. aluminium ladder rack or stainless steel piping). The charge can be induced from a number of sources (e.g. friction, electrical cables or lightning).

5.22.2 Dissipation of Electrostatic Charges

5.22.2.1 Sparks

The charges acquired by two separated materials will tend to recombine. This will happen if the charge is large enough to overcome the strength of any insulation between them - for example, a gas or vapour. The recombination results in a spark, which, if it has sufficient energy, will ignite a flammable vapour.

5.22.2.2 Corona discharge

If a charged object has a sharp point or sharp edge, the charge will concentrate at this point and the resulting effect on the surrounding gas as the charge dissipates may be a faint glow - the corona - accompanied by a hissing sound.

5.22.2.3 Relaxation

Electrostatic charges may be retained for long periods. The retention time depends on the resistance of the non-conductors between the charged substances. This clearly affects the time taken for the charge to leak away. This leaking away is called 'relaxation'.

5.22.3 General Precautions

Most safety rules aim either to reunite the separated charges by bonding or earthing, or to put in place operational procedures that reduce the rate at which charges are produced.

Bonding reunites the charges of one sign on one conductor with those of the opposite sign on another conductor by connecting them with a metal wire. Earthing consists of connecting a conductor, which is carrying a charge or may acquire a charge, to a rod or electrode buried in the earth. This allows the charges to flow harmlessly into the ground.

However, neither earthing nor bonding removes charges from non-conductors, because the charge cannot pass through a non-conductor to reach the earthing point. Thus earthing a tank will not immediately remove the charge from the product inside it.

For this reason, static charges in products can, in the main, only be kept to safe levels, by reducing the rate at which they are produced, (i.e. by reducing the speed of contact and separation). In practice, this means that flow rates must be kept within strict limits and that the introduction of any second phase, particularly water, must be avoided. An alternative method is to increase the conductivity artificially by means of an additive.

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5.22.4 Electrostatic Charges In Petroleum Products

Primarily it is the movement through pipes that brings about the generation of electrostatic charges in products. The faster the movement, the faster the contact and separation resulting in the generation of a greater charge. Other factors affecting charge generation are the presence of dirt, air or water in the product. Their presence provides a multitude of contacting and separating surfaces during product movement, each of which generates a static charge. Water in a product that has been pumped into a tank is particularly significant because, as it settles, contact and separation occur with the surrounding product - a further opportunity for charge generation.

The retention time of an electrostatic charge depends on the electrical conductivity of the product. Black oils, alcohols and fuels containing alcohols (gasohols) are relatively good conductors and therefore do not retain static charges. On the other hand, a distillate product – a relatively poor conductor - will retain a static charge, which can be a serious hazard.

5.22.5 General Earthing and Bonding Practices For Static Electricity

Where an earthing system has been installed for lightning protection, plant and equipment may utilise this for the purpose of earthing static electricity where it is convenient. Alternatively, separate earthing shall be installed for static electricity as follows:

5.22.5.1 Earthing to Dissipate Static Electricity

The flow of electricity during generation and accumulation (of static) can produce potential differences of thousands of Volts, even though the actual flow of electricity is small - in the range of millionths of an Ampere. For this reason, bonding or earthing through a resistance as large as 0.1 MΩ will act as a short circuit to dissipate a static charge.

5.22.5.2 Tanks

Bulk tanks are to be earthed. Where a specific earth connection is not provided on the tank or supporting structure, a connection may be made to a bolt on the tank drain valve.
Underground tanks - No specific earthing points are required. Where cathodic protection is applied earthing of the tank must be avoided.

5.22.5.3 Pipe work

Pipelines associated with high rate filling of vehicles shall be made electrically continuous across joints and fittings as follows, and shall be bonded to earth via the tank.

- Welded joints provide adequate continuity.
- Screwed joints may be assumed to provide sufficient continuity when correctly tightened.
- Flanged joints may be bonded by either of the following methods:
- By utilizing all the normal steel bolts.
- By fitting a 25mm x 3mm copper strap across the joint under one bolt.
- In both cases, all mating faces of bolts, nuts, flanges or copper shall be clean and bright before tightening and the joint should be tested when made, or broken and remade.

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A bond must be provided around joints in which the only contacting surfaces are made of non-metallic insulating material. This does not apply to insulating flanges used in connection with cathodic-protection schemes or ship-shore connections.

5.22.5.4 Hoses

All hoses used for filling or discharging of tanks, vehicles, or packages shall be electrically continuous between couplings.

5.22.5.5 Vacuum Trucks

Suction hoses should be electrically continuous and directly bonded to the vessel that is being cleaned. Non-conductive hoses should not be used.

5.22.5.6 Structures

Vehicle filling shelters in terminals shall be connected to earth via the earthed pipelines and a separate earth electrode provided. A lead bonded to the pipe work and fitted with a clip must be provided on the shelter to enable bonding of the vehicle being loaded. The lead may be either free hung or housed on a spring return reel. The resistance between the bonding wire connection to the structure and the structure earthing point shall not exceed 10 ohms.

5.22.5.7 Bulk delivery vehicles

Bonding of the tank and pipe work to the vehicle chassis is not specified for these vehicles and, provided that the mounting bolts ensure a path resistance less than 50 ohms, no special bonding need be carried out. However, the tank and pipe work of aviation and high rate filling vehicles must be bonded together with a path resistance less than 10 ohms.

To allow bonding of the vehicle to the installation pipe work during filling operations etc., all vehicles should be fitted with lugs brazed or welded to the tank.

5.22.5.8 Rail tank cars

These vehicles are normally sufficiently earthed through the chassis and rail track, thus bonding is not required. Railway signalling voltages do not significantly add to the static hazard.
However a permanent bond connection shall be installed between the rail and the pipe work and structure.

5.22.5.9 Tank ships

In order to prevent the flow of current between ship and shore and subsequent danger of arcing, an insulating flange shall be installed in the shore pipeline close to the connecting point of the hose string so as to effectively insulate the ship from the shore pipeline. The design of the insulating flange joint shall comply with that shown in the 'International Safety Guide for Oil Tankers and Terminals'.

The resistance across the insulating section shall not be less than 1000 ohms, it shall be tested annually and the relevant Marine Authority provided with a record of these tests.

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Adequate precautions shall be taken to prevent any short circuit across this insulating section.

The pipeline and hose on the seaward side of the insulating section shall be electrically continuous to the ship and the pipeline on the shore side of the insulating section shall be electrically continuous to the pipeline earthing system.

5.22.5.10 Man made fibres

Personnel clothing, especially man made fibres, readily generate static electricity. The human body can accumulate a static charge in excess of 10,000 Volts, although when discharged it is short-lived and of low temperature. On hydrocarbon sites conductive footwear is worn to prevent static build up.

5.22.5.11 Pouring Non Conductive Fluids

When pouring non-conducting fluids from a container to a receptacle, then the container, receptacle and funnel, if used, must be bonded together and to earth. All equipment should be of metal. Recipient vessels and loading nozzles or hoses should be bonded to earth during transfer operations

5.22.5.12 Grit blasting, Fine Water Sprays

Other items in common usage, which may cause static electricity build up if not properly earthed are:

- Grit blasting
- Fine water sprays used for fire fighting.

Safeguards should include bonding of nozzles and the use of anti static hoses

5.22.5.13 Electronic Equipment

Electronic Equipment (e.g. CMOS logic) can be very sensitive to electrostatic discharge. Suitable precautions such as the use of earthed wrist straps should be used when handling sensitive electronic equipment (including packing and unpacking). Wristband cords shall be checked prior to use.

5.22.5.14 Insulated Conductive Equipment

When there is a risk of galvanic inter-reaction between dissimilar metals it is normal practice to install insulating pads between these metals. Typical examples include Stainless Steel piping or Stainless Steel or Aluminium cable racks and trays mounted on carbon steel supports.

Where items of plant are deliberately insulated from ground to prevent galvanic corrosion there is the possibility of the build up of a static charge. For this reason, bonding or grounding is required to provide a circuit to dissipate static charge. (Galvanic corrosion occurs between dissimilar metals, but copper is sufficiently noble as to not react with stainless steel and most other materials.)

To ensure that insulated conductive equipment is provided with an adequate charge relaxation path the equipment should be tested with a value of 100,000 Ohms as the limiting factor. If the impedance to earth is above 100,000 Ohms then the source of the high impedance should be identified and rectified.

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5.22.5.15 Non Conductive Cable Trays

In certain circumstances Glass Reinforced Polyester (GRP) cable trays and ladders are used. This material in its native state is non-conducting, but because it is a plastic is capable of accumulating static charge. For this reason GRP trays and ladders need to be manufactured with special anti-static coatings. Generally the manufacturer will provide this as standard.

For GRP junction boxes, etc. The material will be provided with anti-static coatings, this is particularly true of equipment certified EEx'e'.

5.23 Guidance - Electromagnetic Compatibility

Electromagnetic compatibility, or EMC means that a device is compatible with (i.e., no interference is caused by) its electromagnetic (EM) environment and it does not emit levels of EM energy that cause electromagnetic interference (EMI) in other devices in the vicinity. The different forms of EM energy that can cause EMI are conducted, radiated, and electrostatic discharge (ESD).

The equipment installed on site will normally be electro magnetically compatible, however when single core cabling is installed this effect needs to be considered. Effects will normally be mitigated by ensuring that circuit conductors are grouped routed and tied together i.e.3 phase cables are run together in trefoil and DC phase cables are run together as a pair.

5.24 Guidance - Marking and Identification of Phase Cores

Power cables
In 2004 the European Community colour identification of cable cores changed. This creates a problem where old colour systems have to merge with the new. To cover this change wherever phase identification is required the Azerbaijan SPU site markings for phase cores will be used. As given below

Conductors	Old UK Colours	Harmonisation HD308: S2 Colours	**Azerbaijan BU Site markings for phase cores**
Earth	Yellow/Green	Yellow/Green	**Yellow/Green**
Neutral	Black	Blue	**N**
Phase 1	Red	Brown	**L1**
Phase 2	Yellow	Black	**L2**
Phase 3	Blue	Grey	**L3**

Instrument cables
Due to different specifications used during the project there are a number of instrument core identifies being used. For clarification the instrument core identification for Azerbaijan SPU is as seen below

Conductors	CA./SD Drilling BS6883	WA/ EA/DWG Drilling	**Azerbaijan BU Site markings for**

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	BS7655		**phase cores**
1	White	Black	**1**
2	Black	Blue	**2**
3	Red	Brown	**3**
4	Blue	Grey	**4**

6 Key Documents / Tools / References

GNPM29 HSE(UK)	Electrical risks from steam/water pressure cleaners.
GNGS38 HSE(UK)	Electrical test equipment for use by electricians.
GMPM38 HSE(UK)	Selection and use of electric hand lamps.
HSE730/11 HSE(UK)	Temporary electrical installations in ship building and ship repairing.
HS(G) 118 HSE(UK)	Electrical safety in Arc welding.
HSR25 HSE(UK)	Memorandum of guidance on the electricity at work regulations 1989.
N/A	Safety in electrical testing at work.
GS6 HSE (UK)	Avoidance of danger from overhead electric power lines.
MOSCOW ENERGOAT OMIZDAT 1988	Standard code for customer electrical installations and safety regulations for operation of customer electrical installations.
OSHA(USA)	Occupational Safety and Health Administration.
BS 7671(2001 AMD14905 (march 2004)	16th Edition Wiring Regulation Amendment No 2.
BS 6656	Guide to the prevention of inadvertent ignition of flammable atmospheres.
BS EN 1834-1	Reciprocating internal combustion engines – safety requirements for design and construction of engines for use in potentially explosive atmospheres Part 1: Group II engines for use in flammable gas or vapour atmospheres.
API RP-2003	5th Edition, 1991 entitled 'Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents'.
HSG47 HSE (UK)	Avoiding danger from underground services.
N/A	Australian Pipeline Industry Association safety guidelines- Electrical Hazards.
N/A	Worker Compensation Board of British Columbia working Safely Around Electricity.

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Review / Revision Log

Revision Date	Authority	Custodian	Revision Details
05 December 2008	AzSPU Central Engineering Senior Authority Houghton, Chris	AzSPU Electrical Technical Authority Hepburn Yvonne	Authority position/name and custodian name have changed to reflect org changes in HSE&TD
02 February 2010	AzSPU Central Engineering Senior Authority Houghton, Chris	AzSPU Electrical Technical Authority Hepburn Yvonne	The guidelines are issued as separate document. Document template has been changed in accordance with the Standardized Document Management Template **Section 5.24** updated for instrument cables color codes across sites

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