Skill Wind

Health and Safety

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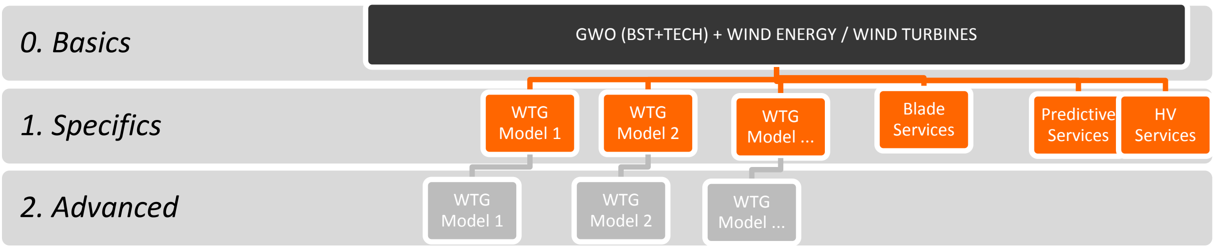
TRAINING PATHS



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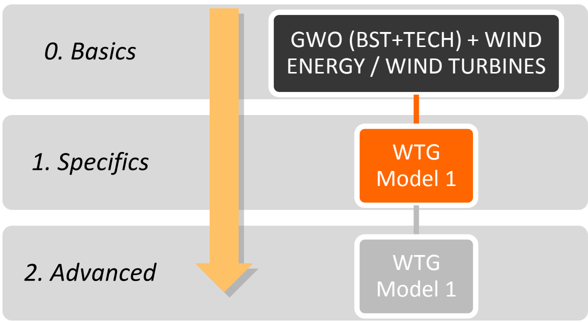
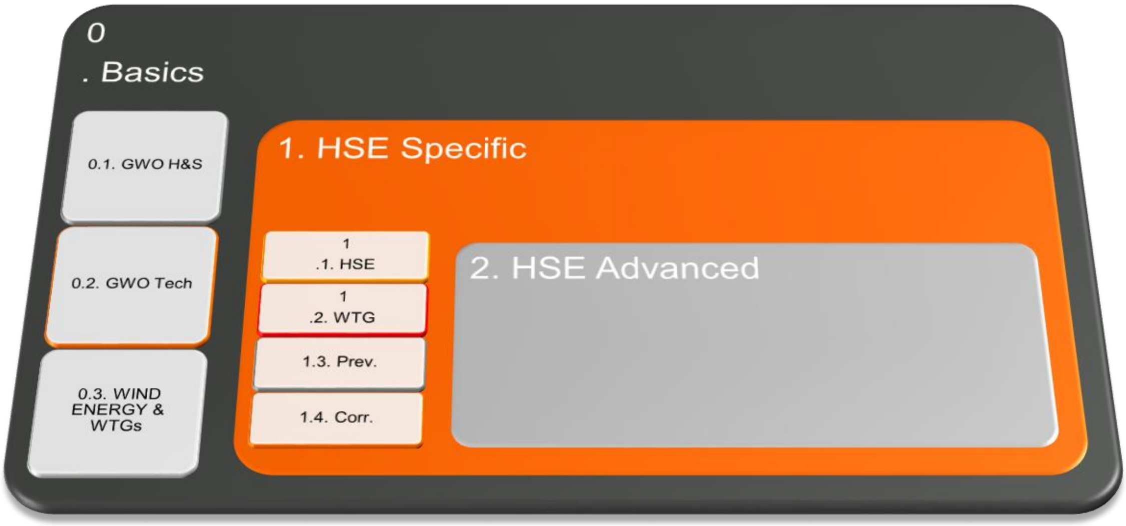
PATH #1. HEALTH & SAFETY

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GWO BST FIRST AID

1.1.1. Introduction

Even if the primary objective of H&S is to reduce the risk of injury or illness at work, those risks can't be entirely eliminated. Therefore proper procedures must be implemented to minimize the effects on a person aiming at:

- Preserve life, applying first aid techniques;
- Prevent further harm, reducing the risk of the condition worsening;
- Promote recovery, by enabling the start of the recovery process.

As usual, a fully shared definition of First Aid is yet to come, but trying to gather the several characteristics of those we can summarize that First Aid all those activities in cases where a person will need help from a medical practitioner or nurse, treatment for the purpose of preserving life and minimizing the consequences of injury and illness until such help is obtained, as well as the treatment of minor injuries where no medical support is necessary.

Therefore, First Aid is clearly focused on preserving life and minimizing consequences; the exact scope of assistance that may have to be provided to the casualty depends on where and when medical support can be obtained.

First aid provision should be integrated with the Emergency Response Plan for the wind farm, and is likely to comprise successive levels of support, for example:

- The immediate response is likely to be provided by the casualty's colleagues in the working party; they will raise the alarm, and where it is safe to do so, rescue the casualty from immediate danger and provide initial first aid within the remit of their training;
- Other personnel within the wind farm may provide further assistance in the care of the casualty, particularly where they have more advanced first aid training; they may also assist with casualty evacuation;

Each level of support must be capable of taking care of the casualty until the next level of support is available, until the casualty is handed over to full medical care.

1.1.2. **Legislation/Risks/Hazards**

1.1.2.1. RISKS

The risks to people will both vary over the lifecycle, as will the level of support available within the wind farm; a typical pattern could be:

- During construction:
  - ✓ Large numbers of people will be undertaking high-hazard activities;
  - ✓ The workforce will be provided by multiple contractors, often from a number of different countries;
  - ✓ Construction site welfare facilities will be more comprehensive than on the completed site;
- During commissioning:
  - ✓ Most heavy lifting and assembly work will have ceased; electrical systems will be energized, and moving machinery will be present;
  - ✓ The workforce will be smaller, provided by a reduced number of employers;
- During operations and maintenance:
  - ✓ The work will be very varied, ranging from low-hazard inspection activities to repair or replacement of major components;
  - ✓ Only the largest wind farms will have a core on-site workforce; on most sites, teams will be mobilized to sites when required;
  - ✓ The combined effect of these is that the level of risk to people on a site, the number of personnel on site, and their level of training, will vary on a daily basis.

1.1.2.2. HAZARDS

Wind farms presents a variety of hazards that the first aid provision may have to address:

- There is the potential for complex and difficult injuries to occur, such as suspension intolerance / syncope, electric shock, major trauma, crushing / entrapment, hypothermia, and heat stress;

- Injuries may occur in locations that are difficult to access, or in restricted working positions such as work at height or in confined spaces;
- Underlying medical conditions may give rise to acute illness;
- Wind farms are often located in remote locations, potentially delaying the arrival of emergency services;
    - ✓ Ambulances may not be able to use site roads, so it may be necessary to transport a casualty to an agreed location;
    - ✓ If paramedics attend a site, they may not have the necessary training to attend a casualty in a WTG.

It should be noted that, in general, the emergency services will only become involved if there is a danger to life; in less critical cases, the resources of the wind farm should be capable of providing all necessary care and evacuation; the detailed interfaces will be defined in the ERP, including limitations on areas that emergency services can be expected to access.

1.1.2.3. LEGISLATION

The Health and Safety (First-Aid) Regulations require employers to provide "adequate and appropriate" equipment, facilities and personnel to ensure that their employees receive immediate assistance if they are injured or taken ill at work; the regulations do not prevent personnel with appropriate training from taking action beyond initial casualty management. In summary, the regulations require duty holders to:

- Assess the first aid needs of a workplace, to determine what will constitute adequate and appropriate provision, based on the circumstances of a particular workplace;
- Based on the assessment of needs, provide:
    - ✓ A suitable number of persons, with an appropriate level of training, for rendering first-aid to employees; and
    - ✓ The necessary first aid materials, facilities and equipment;
- Ensure that persons who provide first aid are competent and trained to an appropriate level; fulfilling this duty may involve:

    - ✓ Assessing the suitability of available first aid qualifications, and the competence of training providers, and
    - ✓ Providing additional training, if standard qualifications do not give sufficient preparation for the situations that may occur in the workplace; and
- Inform employees of the arrangements that have been made for first aid provision.

During the construction phase, the Principal Contractor has a duty to define the arrangements for provision of first aid, as part of the construction phase plan, and to inform personnel of the arrangements as part of their site induction. On a multi-occupied site, the different employers should co-operate to ensure that their combined or shared first aid provision is adequate, with respect to the hazards and risks on the site, and that employees are kept informed of arrangements.

The HSE provides guidance on the syllabus of standard Emergency First Aid at Work and First Aid at Work courses, however the duty to provide additional training where necessary is particularly relevant to wind farms. The HSE no longer approves any first aid training courses or qualifications; it is the employer's duty to select a competent training provider. This duty can be fulfilled through various different approaches, including:

- Voluntary approval schemes, with third party accreditation against an industry standard; o This allows for the development of first aid training that is targeted at the specific
- needs of an industry;
- Approval by a qualification regulator;
- Operation within the assurance systems of a Voluntary Aid Society; or
- Direct provision of evidence to the employer;

1.1.3. **Anatomy**

The human body is composed of a number of 'systems', each with a specific role in the function of the body as a whole. The function of these individual systems is known as the body's physiology.

It is important that first aiders, first responders and ambulance staff have a basic awareness of the major systems and their functions. Knowledge of human anatomy will assist you in understanding key topics in pre-hospital care, and will also provide a firm basis for the care and treatment of a casualty.

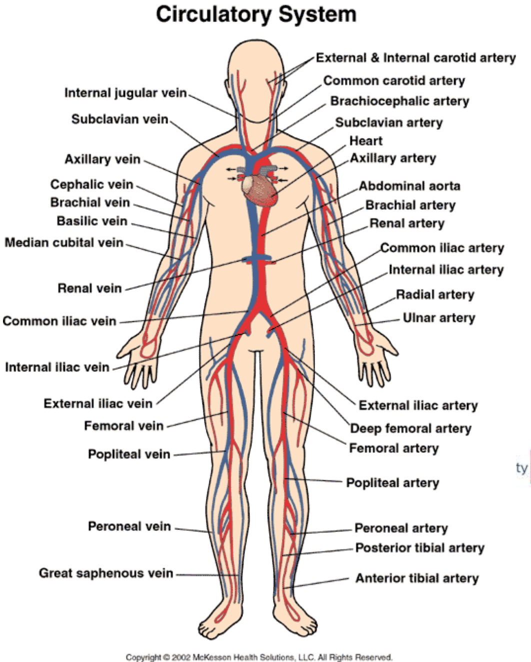
Essentially, there are ten (10) anatomical systems, with some more important to first aiders than others.

1.1.3.1. THE NERVOUS SYSTEM

The nervous system is considered in two main parts, the Central Nervous System (CNS) and the Peripheral Nervous System (PNS). The Central Nervous System comprises the brain and spinal cord. This is the control centre for all functions of the body, and is the most complex of all body systems. The brain regulates all body functions, including the respiratory and cardiovascular systems. It is easy to see how damage to the central nervous system (e.g.: a spinal cord injury) can have disastrous effects to body functions.

The motor and sensory nerves, which involve movement, are known as the Peripheral Nervous System, and these function as directed by the brain. Some peripheral nerves function without conscious thought, and these are known as autonomic nerves. Breathing is a function that is attributable to these nerves.

1.1.3.2. THE CARDIOVASCULAR SYSTEM



This system involves the heart, blood vessels and blood. The heart is the pump that drives the circulation of the blood around the body. The body's main vessels are arteries, which take the blood from the heart, and veins, which return the blood to the heart.

There are smaller blood vessels such as arterioles, venules and capillaries, most of which are located at the body's extremities and usually close to the skin.

Blood is the medium that transports oxygen, from the respiratory system to the body's cells. Blood also transports sugars, chemicals, proteins, hormones, and many other substances around the body for use and elimination.

As the heart pumps blood a pulse beat can be felt at various locations in the body, and each pulse beat corresponds to one heartbeat. The heart rate of the average adult at rest is between 60 to 100 beats per minute, depending on age, medical conditions and general fitness. The most accessible pulse points are the carotid (neck) and radial (wrist) arteries.

A working knowledge of the locations of these pulse points is important for the first aid provider. However, finding a pulse can sometimes be extremely difficult, and looking for other signs of circulation, such as skin color, warmth, movement or coughing is essential.

1.1.3.3. THE RESPIRATORY SYSTEM

This system is composed of the airway (mouth, nose, trachea, larynx, bronchi, bronchioles) and the lungs (including the small air sacs called alveoli).

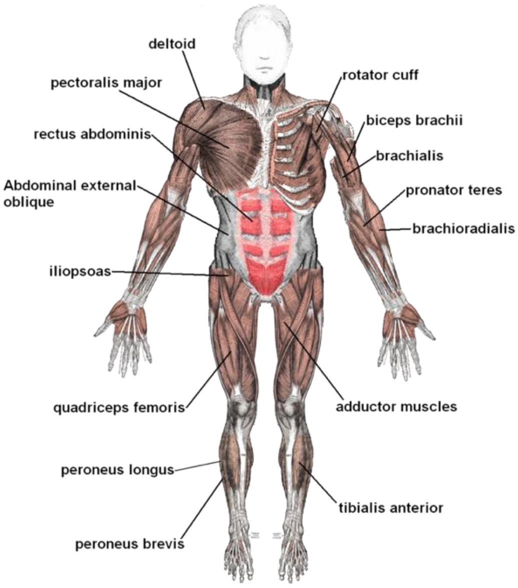
The function of the respiratory system is to provide oxygen to the blood, and take away the waste product called carbon dioxide.

Oxygen is extracted from the air that is inhaled via the airway, and is passed into the blood stream through the membranes of the lungs. For the first aid provider, the maintenance of a casualty's airway is of primary importance.

1.1.3.4. THE DIGESTIVE SYSTEM

This system includes the esophagus, stomach and intestines. Drink and food are passed via the esophagus to the stomach where they are processed for further digestion. They are then absorbed into the body through the membranes of the intestines. Some organs, such as the liver and pancreas are considered accessories to the digestive system as they assist in the processing of food into various chemical substances used by the body.

1.1.3.5. THE MUSCULOSKELETAL SYSTEM



This system involves the bones, ligaments, tendons and muscles which support the body, protect the internal organs, and allow for movement.

Most muscles that cause movement work by contracting and relaxing in conjunction with a bone. The action of raising your leg involves the contraction of several muscles creating an opposing force in the leg, causing it to move upwards. Some muscles, such as the diaphragm that makes the lungs expand and contract, do not need bones to work with, but function attached to large masses of tissue.

1.1.3.6. THE URINARY SYSTEM

This is an important system that flushes waste products suspended in fluid from the body. It includes the kidneys, bladder and urinary tract, and plays a vital role in maintaining the body in a healthy state.

Should the urinary system fail (especially the kidneys), then the affected person requires external assistance to get rid of the waste products by ‘flushing’ the blood. This is called hemodialysis or, more commonly, ‘dialysis’.

1.1.3.7. THE ENDOCRINE SYSTEM

This system involves those organs and glands that secrete chemicals in the form of hormones to stimulate and activate the body’s functions. The pancreas for example, controls a variety of important functions by releasing insulin, and influencing the body’s metabolic process.

1.1.3.8. THE LYMPHATIC SYSTEM

This system provides lymphatic fluid that drains from the body's tissues. This is important as a 'flushing' mechanism, and most toxins and infections absorbed or injected into the tissues are collected by the lymphatic system and 'strained' through lymph nodes in the armpits, neck and groin. The lymphatic fluid eventually drains into the blood stream.

The lymphatic system is a slow-moving system, and is where toxins like snake venom tend to accumulate after the bite has occurred. By applying a pressure immobilization bandage it is possible to slow or even stop the lymphatic system, and therefore reduce the movement of toxins entering the circulation.

1.1.3.9. THE REPRODUCTIVE SYSTEM

This is linked to the body's endocrine system, through the female's ovaries and the male's testes. These are known as the gonads, or 'sex glands'. The female reproductive system consists of the ovaries which produce the human egg, the uterus (or 'womb') where the fertilized egg is lodged for growth, and the vagina with the associated 'birth canal'. The male reproductive system is composed of the testes, which produce sperm, the seminal vesicle that provides the fluid medium for the sperm, and the penis.

1.1.3.10. THE INTEGUMENTARY SYSTEM

This is the system that includes skin, hair, finger and toenails. Their pigmentation (color) and growth are linked to the endocrine system.

The skin is the body's largest organ, and plays an important role in protecting the body from infections. In addition the skin performs a number of other functions such as acting as a shield against injury and keeping body fluids in. The skin is made from tough, elastic fibers which have the ability to stretch without tearing easily.

1.1.4. Lifesaving First Aid Primary Survey A – B – C:

In case of an accident, the Primary Survey A-B-C is the first group of action the first aider must perform. A-B-C is an acronym standing for:

AIRWAYS: Ensure airways are open and unblocked. If they are unconscious, tilt the head back and lift their chin to open the airway.

BREATHING: Establish if the victim is breathing normally by looking, listening or feeling for breaths. Different action has to undertaken if the victim is unconscious but breathing normally or if the victim is unconscious and not breathing.

CIRCULATION: Look for signs of severe bleeding once the other checks have been made. Pressure should be applied to the bleeds and the affected limb raise above heart level. The casualty should be monitored and treated for signs of shock.

1.1.4.1. UNRESPONSIVE AND BREATHING NORMALLY

The priority management of a breathing but unresponsive victim is the maintenance of an open airway. Victims with agonal breathing should be placed in the recovery position.

In certain situations such as trauma, it may not be appropriate to move the individual into a recovery position.

- kneel beside the victim and make sure that both legs are straight,
- place the arm nearest to you out at right angles to the body, elbow bent with the hand palm uppermost;
- bring the far arm across the chest, and hold the back of the hand against the victim’s cheek nearest to you;
- with your other hand, grasp the far leg just above the knee and pull it up, keeping the foot on the ground;
- keeping the hand pressed against the cheek, pull on the far leg to roll the victim towards you onto his or her side;

- adjust the upper leg so that both hip and knee are bent at right angles;
- tilt the head back to make sure the airway remains open;
- adjust the hand under the cheek if necessary, to keep the head tilted and facing downwards to allow liquid material to drain from the mouth;
- check breathing regularly.

If the victim has to be kept in the recovery position for more than 30 min turn him or her to the opposite side to relieve the pressure on the lower arm.

1.1.4.2. UNRESPONSIVE AND NOT BREATHING NORMALLY

1. Opening the airway and checking for breathing: assess the collapsed victim rapidly to determine if they are responsive and breathing normally. Open the airway using the head tilt and chin lift technique whilst assessing whether the person is breathing normally. Do not delay assessment by checking for obstructions in the airway. The jaw thrust and finger sweep are no longer recommended for the lay provider.

2. Alerting emergency services: 112 is the European emergency phone number, available every- where in the EU, free of charge. It is possible to call 112 from fixed and mobile phones to contact any emergency service: an ambulance, the fire brigade or the police. Some European countries provide an alternative direct access number to emergency medical services, which may save time. Early contact with the emergency services will facilitate dispatcher assistance in the recognition of cardiac arrest, telephone instruction on how to perform CPR, emergency medical service/first responder dispatch, and on locating and dispatching of an AED.

3. Starting chest compressions: In adults needing CPR, there is a high probability of a primary cardiac cause. When blood flow stops after cardiac arrest, the blood in the lungs and arterial system remains oxygenated for some minutes. To emphasize the

priority of chest compressions, it is recommended that CPR should start with chest compressions rather than initial ventilations.

When providing manual chest compressions:

1. Deliver compressions ‘in the centre of the chest’.
2. Compress to a depth of at least 5 cm but not more than 6 cm.
3. Compress the chest at a rate of 100–120 min−1 with as few interruptions as possible.
4. Allow the chest to recoil completely after each compression; do not lean on the chest.

Hand position

Chest compressions are most easily delivered by a single CPR provider kneeling by the side of the victim, as this facilitates movement between compressions and ventilations with minimal interruptions.

Mouth-to-mouth ventilation

CPR providers should aim for an inflation duration of about 1 s, with enough volume to make the victim’s chest rise, but avoid rapid or forceful breaths. The maximum interruption in chest compression to give two breaths should not exceed 10 s.

Mouth-to-nose ventilation

Mouth-to-nose ventilation is an acceptable alternative to mouth-to-mouth ventilation. It may be considered if the victim’s mouth is seriously injured or cannot be opened, the CPR provider is assisting a victim in the water, or a mouth-to-mouth seal is difficult to achieve.

1.1.4.3. OBSTRUCTION OF AIRWAYS

Foreign body airway obstruction (FBAO) is an uncommon but potentially treatable cause of accidental death. As most choking events are associated with eating, they are commonly witnessed. As victims initially are conscious and responsive, there are often opportunities for early interventions which can be life saving.

Because recognition of airway obstruction is the key to successful outcome, it is important not to confuse this emergency with fainting, myocardial infarction, seizure or other conditions that may cause sudden respiratory distress, cyanosis or loss of consciousness.

It is important to ask the conscious victim “Are you choking?” The victim that is able to speak, cough and breathe has mild obstruction. The victim that is unable to speak, has a weakening cough, is struggling or unable to breathe, has severe airway obstruction.

Treatment for mild airway obstruction

Coughing generates high and sustained airway pressures and may expel the foreign body. Aggressive treatment with back blows, abdominal thrusts and chest compressions, may cause harm and can worsen the airway obstruction. These treatments should be reserved for victims who have signs of severe airway obstruction. Victims with mild airway obstruction should remain under continuous observation until they improve, as severe airway obstruction may subsequently develop.

Treatment for severe airway obstruction

For conscious adults with complete FBAO, case reports have demonstrated the effectiveness of back blows or ‘slaps’, abdominal thrusts and chest thrusts. Approximately 50% of episodes of airway obstruction are not relieved by a single technique. The likelihood of success is increased when combinations of back blows or slaps, and abdominal and chest thrusts are used.

1.1.4.4. BLEEDING

The best control of bleeding is to apply direct pressure to the wound where possible. Localised cold therapy, with or without pressure, may be beneficial in haemostasis for minor or closed bleeding in extremities although this is based on in-hospital evidence.

Where bleeding cannot be controlled by direct pressure it may be possible to control bleeding by the use of a haemostatic dressing or a tourniquet.

Haemostatic dressings are commonly used to control bleeding in the surgical and military settings especially when the wound is in a non-compressible area such as the neck, abdomen, or groin. Use a haemostatic dressing when direct pressure cannot control severe external bleeding or the wound is in a position where direct pressure is not possible.

Haemorrhage from vascular injured extremities may result in life-threatening exsanguination and is one of the leading causes of preventable death on the battlefield and in the civilian setting. Initial management of severe external limb bleeding is direct pressure but this may not be possible and even a tight compression bandage directly over the wound may not completely control major arterial bleeding.

Use a tourniquet when direct wound pressure cannot control severe external bleeding in a limb.

1.1.4.5. SHOCK

Shock is a condition in which there is failure of the peripheral circulation. It may be caused by sudden loss of body fluids (such as in bleeding), serious injury, myocardial infarction (heart attack), pulmonary embolism, and other similar conditions. While the primary treatment is usually directed at the cause of shock, support of the circulation is important.

The use of passive leg raising (PLR) may provide a transient (<7 min) improvement in heart rate, mean arterial pressure, cardiac index, or stroke volume; for those with no evidence of trauma.

These recommendations place an increased value on the potential, but uncertain, clinical benefit of improved vital signs and cardiac function, by positioning a victim with shock in the supine position (with or without PLR), over the risk of moving the victim. Place individuals with shock into the supine (lying on back) position. Where there is no evidence of trauma use passive leg raising to provide a further transient (<7 min) improvement in vital signs but the clinical significance of this transient improvement is uncertain.

SEQUENCE / Action		Technical description
SAFETY Make sure you, the victim and any bystanders are safe		
RESPONSE Check the victim for a response		Gently shake his shoulders and ask loudly: "Are you all right?" If he responds leave him in the position in which you find him, provided there is no further danger; try to find out what is wrong with him and get help if needed; reassess him regularly
AIRWAY Open the airway		Turn the victim onto his back if necessary Place your hand on his forehead and gently tilt his head back; with your fingertips under the point of the victim's chin, lift the chin to open the airway
BREATHING Look, listen and feel for normal breathing		In the first few minutes after cardiac arrest, a victim may be barely breathing, or taking infrequent, slow and noisy gasps. Do not confuse this with normal breathing. Look, listen and feel for **no more** than 10 seconds to determine whether the victim is breathing normally. If you have any doubt whether breathing is normal, act as if it is they are not breathing normally and prepare to start CPR
UNRESPONSIVE AND NOT BREATHING NORMALLY Alert emergency services		Ask a helper to call the emergency services (112) if possible otherwise call them yourself Stay with the victim when making the call if possible Activate speaker function on phone to aid communication with dispatcher
SEND FOR AED Send someone to get AED		Send someone to find and bring an AED if available. If you are on your own, do not leave the victim, start CPR

CIRCULATION

Start chest compressions

Kneel by the side of the victim

Place the heel of one hand in the centre of the victim's chest; (which is the lower half of the victim's breastbone (sternum))

Place the heel of your other hand on top of the first hand

Interlock the fingers of your hands and ensure that pressure is not applied over the victim's ribs

Keep your arms straight

Do not apply any pressure over the upper abdomen or the bottom end of the bony sternum (breastbone)

Position yourself vertically above the victim's chest and press down on the sternum at least 5 cm but not more than 6 cm.

After each compression, release all the pressure on the chest without losing contact between your hands and the sternum

Repeat at a rate of 100-120 min^{-1}

IF TRAINED AND ABLE

Combine chest compressions with rescue breaths

After 30 compressions open the airway again using head tilt and chin lift

Pinch the soft part of the nose closed, using the index finger and thumb of your hand on the forehead

Allow the mouth to open, but maintain chin lift

Take a normal breath and place your lips around his mouth, making sure that you have a good seal

Blow steadily into the mouth while watching for the chest to rise, taking about 1 second as in normal breathing; this is an effective rescue breath

Maintaining head tilt and chin lift, take your mouth away from the victim and watch for the chest to fall as air comes out

Take another normal breath and blow into the victim's mouth once more to achieve a total of two effective rescue breaths. Do not interrupt compressions by more than 10 seconds to deliver two breaths. Then return your hands without delay to the correct position on the sternum and give a further 30 chest compressions

IF UNTRAINED OR UNABLE TO DO RESCUE BREATHS

Continue compression only CPR

WHEN AED ARRIVES

Switch on the AED and attach the electrode pads

Follow the spoken/visual directions

If a shock is indicated, **deliver shock**

If no shock is indicated, continue CPR

IF NO AED IS AVAILABLE CONTINUE CPR Continue CPR		Do not interrupt resuscitation until: • a health professional tells you to stop • the victim is definitely waking "up", moving, opening eyes and breathing normally • you become exhausted
IF UNRESPONSIVE BUT BREATHING NORMALLY If you are certain the victim is breathing normally but is still unresponsive, place in the recovery position (see First aid chapter).		It is rare for CPR alone to restart the heart. Unless you are certain the person has recovered continue CPR Signs the victim has recovered • waking up • moving • opens eyes • normal breathing Be prepared to restart CPR immediately if patient deteriorates

1.1.5. AED

AEDs make it possible to defibrillate many minutes before professional help arrives. CPR providers should continue CPR with minimal interruption of chest compressions while attaching an AED and during its use. CPR providers should concentrate on following the voice prompts immediately when they are spoken, in particular resuming CPR as soon as instructed, and minimizing interruptions in chest compression. Indeed, pre-shock and post-shock pauses in chest compressions should be as short as possible.

<u>Voice prompts</u>

It is critically important that CPR providers pay attention to AED voice prompts and follow them without any delay. Voice prompts are usually programmable, and it is recommended that they be set in accordance with the sequence of shocks and timings for CPR given above. These should include at least:

1. minimize pauses in chest compressions for rhythm analysis and charging;

2. a single shock only, when a shockable rhythm is detected;
3. a voice prompt for immediate resumption of chest compression after the shock delivery;
4. a period of 2min of CPR before the next voice prompt to reanalyze the rhythm.

Fully-automatic AEDs

Having detected a shockable rhythm, a fully automatic AED will deliver a shock without further action from the CPR provider.

1.1.6. Ordinay First Aid

Only move onto the Secondary Survey if you've already done the Primary Survey and succeeded in dealing with any life-threatening conditions.

Then you can start questioning the casualty about what's happened and carefully check someone for any other injuries or illnesses. If you can, jot down everything you find out and give all this information to the emergency services or whoever takes responsibility for the child, like a parent.

EVENT HISTORY

Ask them to describe exactly what happened leading up to them feeling unwell or injuring themselves.

You can ask other people near the scene too and also look for clues. For example, if they've had a car accident the impact on the car will help you work out what type of injury they could have.

MEDICAL HISTORY

Then, ask them to tell you their medical history. Use the word AMPLE to remember all the things you need to ask them:

Allergy – do they have any allergies?

Medication – are they taking any regular or prescribed medication?

Previous medical history – did they already have any conditions?

Last meal – when did they last eat something?

Event history – what happened?

SYMPTOMS

Ask them to give you as much detail as possible about how they feel. Listen carefully to what they say and make notes, if possible.

- Here are they key questions to ask them:
- Can they feel any pain?
- Can they describe the pain, e.g. is it constant or irregular, sharp or dull?
- What makes the pain better or worse?
- When did the pain start?

SIGNS

Check the casualty over from head to toe, using all your senses – look, listen, feel and smell.

You may have to loosen, open, cut away or remove clothing. Ask their permission to do this and make sure you're sensitive and discreet.

Make a note of any minor injuries as you go. Only return to these when you have finished checking the whole body, to make sure you don't miss any more serious injuries.

HEAD TO TOE EXAMINATION

Breathing and pulse: How fast and strong is their breathing and pulse?

Bleeding: Check the body from head-to-toe for any bleeding.

Head and neck: Is there any bleeding, swelling, sensitivity or a dent in the bone, which could mean a fracture?

Ear: Do they respond when you talk to them? Is there any blood or clear fluid coming from either ear? If so, this could mean a serious head injury.

Eyes: Are they open? What size are their pupils (the black bit)? If they're different sizes this could mean a head injury.

Nose: Is there any blood or clear fluid coming from the nostrils? This could mean a serious head injury.

Mouth: Check their mouth for anything which could block their airway. Look for mouth injuries or burns in their mouth and anything unusual in the line of their teeth.

Skin: Note the colour and temperature of their skin. Pale, cold, clammy skin suggests shock. A flushed, hot face suggests fever or heatstroke. A blue tinge suggests lack of oxygen from an obstructed airway, poor circulation, or asthma.

Neck: Loosen any clothing around their neck to look for signs like a medical warning medallion or a hole in their windpipe. Run your fingers down their spine without moving it to check for any swelling, sensitivity or deformity.

Chest: Check if the chest rises easily and evenly on each side as they breathe. Feel the ribcage to check for any deformity or sensitivity. Note if breathing is difficult for them or painful in any way.

Collar bone, arms and fingers: Feel all the way along the collar bones to the fingers for any swelling, sensitivity or deformity. Check they can move their elbows, wrists and fingers.

Arms and fingers: Check they don't have any unusual feeling in their arms or fingers. If their fingertips are pale or greyish-blue this could suggest their blood isn't circulating properly. Also look for any needle marks on the forearms, which suggest drug use. See if they have a medical warning bracelet.

Spine: If they've lost any movement or sensation in their legs or arms. Don't move them to check their spine as they may have a spinal injury. Otherwise, gently put your hand under their back and check for any swelling or soreness

Abdomen: Gently feel their abdomen to check for any signs of internal bleeding, like stiffness or soreness, on each side.

Hips and pelvis: Feel both hips and the pelvis for signs of a fracture. Check their clothing for any signs of incontinence, which may suggest a spinal injury or bladder injury, or bleeding from body openings, which may suggest a pelvic fracture.

Legs: Check the legs for any bleeding, swelling, deformity or soreness. Ask them to raise one leg and then the other, and to move their ankles and knees.

Toes: Check their movement and feeling in their toes. Compare both feet and note the colour of the skin: greyish-blue skin could suggest a problem with their circulation or an injury due to cold, like hypothermia.

GWO BST MANUAL HANDLING

1.2.1 INTRODUCTION

Manual handling of loads may cause cumulative disorders due to gradual and cumulative deterioration of the musculoskeletal system through continuous lifting / handling activities, e.g. low back pain. It can also cause acute trauma such as cuts or fractures due to accidents.

Work-related low back pain and injuries are the most common musculoskeletal disorders caused by manual handling.

Factors that increase the risk of injury include the load being too heavy, large, difficult to grasp or unstable, the task being too strenuous or involving awkward postures or movements, and the working environment lacking sufficient space, having slippery, uneven or unstable floors, having extreme temperatures or poor lighting.

Individual factors also make some workers especially vulnerable.

Prevention measures may include:

- Designing and organising tasks to avoid manual handling completely, or at least restrict it.
- Using automation and lifting equipment.
- Organising manual handling tasks in a safe way, with loads split into smaller ones, and proper rest periods provided.
- Providing information and training to workers on tasks, and the use of equipment and correct handling techniques.

1.2.2 LEGISLATION

Workers are protected against work-related musculoskeletal disorders by health and safety guidelines and Directives. One such is **Council Directive 90/269/EEC**, which sets out health and safety requirements for the manual handling of loads, particularly where there is a risk of back injury to workers. The Directive places the following general obligations on employers:

- To avoid the need for manual handling of loads
- To take the appropriate organisational measures to reduce the risk if manual handling cannot be avoided
- To ensure that workers receive adequate information on the weight of a load, the centre of gravity, or the heaviest side when a package is unevenly loaded
- To provide proper training and precise information on how to handle loads correctly.

The requirements of other European Directives standards (e.g. ISO standards) and guidelines, together with provisions within individual Member States, may also be relevant to the prevention of work-related health problems caused by manual handling.

1.2.3 RISKS AND HAZARDS

Many operations in WTGs present ergonomic difficulties, such as:

- In some types of WTG, access from the tower to the nacelle is obstructed by major components in the nacelle, making it difficult for technicians to undertake this transfer without putting themselves at risk by disconnecting from the fall-arrest systems; or
- Access to components for servicing can be very awkward, involving kneeling, twisting and reaching, which increase the strain involved in carrying out otherwise straightforward tasks.

Where work is carried out in the open air, such as preparing loads for lifting, the people involved may be working in cold, wet conditions, wearing PPE for weather protection. The use of gloves (or having cold hands) will reduce dexterity, making otherwise simple tasks, such as pressing the correct buttons on a handheld radio, more difficult. The selection of equipment, and design of tasks, should take account of the environment in which the work is to be carried out. Poor ergonomics increases the risk of immediate injury or long term development of musculoskeletal disorders; these could be caused by factors such as:

- Restricted space on the yaw deck, or in the nacelle of a WTG, forcing the adoption of awkward working positions; or
- Regular ladder climbing, if servicing WTGs that do not have lifts. The susceptibility of workers to musculoskeletal disorders may be increased by the combination of such activities, which present both repetitive and positional stresses.
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The ability to adapt WTGs, workplaces and systems to achieve good ergonomic standards is greatest at the design and prototype stage; if a need for modifications is identified later in the lifecycle, when such issues become more obvious, then the cost of adaptation will be much higher. Where poor ergonomic design is identified as introducing a risk of injury or long term adverse health effects, the ALARP principle should be applied in deciding on risk reduction measures.

Ergonomic issues should be considered during WTG selection, to ensure that foreseeable maintenance tasks can be undertaken without unacceptable risk; early consideration of these ssues can ensure the greatest benefit at a lower cost than would be possible later in the lifecycle.

The construction industry has one of the highest rates of musculoskeletal disorders. Construction work presents many manual handling challenges: while deliveries of tools and materials will generally be carried out using vehicles and cranes, the last stage of moving items to where they are needed will often involve manual effort, whether pushing, pulling or lifting. Operations such as erecting shuttering, assembling reinforcing bar in foundations, and laying cables in trenches, can all involve manual handling.

During the O&M phase, ergonomics should be considered when carrying out risk assessments of individual tasks, and mitigation such as the provision of suitable access, tools, lighting and ventilation should be implemented as required.

Ergonomic and manual handling issues should be considered in the design phase, as this allows the greatest potential for elimination of hazards, and can simplify subsequent installation and O&M activities. Considerations include:

- Design for construction, including ensuring that safe access is available on part-completed structures, or when temporary works are in place on a site;
- Design for maintenance and access, including:
  - ✓ Consideration of the working environment, in terms of:
    - Space to work, including lay down of components and tools during maintenance tasks, without creating undue congestion or introducing tripping or falling object hazards;
    - Workplace conditions such as temperature and ventilation;
    - The level of lighting, which not only affects the ability of technicians to move around and work safely, but, if poor, can also encourage the adoption of awkward postures;
    - Provision of safe access for foreseeable tasks, so that there is no temptation to use inappropriate means such as climbing on handrails or equipment, in order to get the job done;
    - The effects of foreseeable deviations from normal operation, such as ensuring that dropped objects can be retrieved safely, and that spills or leakage can be contained and cleaned up;
  - ✓ Provision of suitable lifting equipment in nacelle / machinery spaces to minimise manual handling;

- Design for isolation:
  - ✓ Clear and accurate labelling and identification of components and isolators to assist WTSR compliance, in convenient locations for the task;

As ergonomics is about the interaction of people with equipment and systems, the range of physical and psychological characteristics of different people should be considered, as a task or workplace that suits one person may cause problems for another.

In the construction phase, there will be a great variety of manual handling operations, often with subtle differences occurring between occasions when the same task is carried out; for example, lifting a load when it is dry and easily gripped, will present lower risks than lifting the same load when it is wet or slippery, as such factors may force the adoption of a more awkward technique. Generic manual handling assessments of foreseeable tasks should be backed up by thorough training, so that site personnel can carry out a dynamic assessment of risks that a specific activity involves, supported by a culture that encourages people to identify risks and find safe methods, rather than to put themselves at risk in order to allow the work to progress.

Ergonomic risks can be identified by:

- Reviewing designs and operating procedures, to assess the layout of equipment, available access, and the requirements of maintenance tasks;
    - This should be informed by the learning gained through experience on other developments;
- Observation of tasks being carried out, and discussion of ergonomic issues with employees; and
- Reviewing errors, incidents and reports of discomfort to identify where ergonomic problems may be present.

For complex ergonomic issues, specialist help may be obtained from ergonomists. Resolution of issues should be prioritised, taking account of activities where individuals may have a high level of exposure, such as regular service activities, or construction activities where specialist teams undertake the task repeatedly. Ergonomic risks may change over time; for example, when work is being carried out on HV systems, or following cable damage, a WTG may be entirely isolated from all sources of power; this leaves any workers on it dependent on emergency lighting systems and torches, and unable to use powered lifting equipment to move loads, or the tower lift to access the nacelle. Risk assessments for work under these conditions should address the provision of generators if access is likely to be required for longer than the emergency lighting is maintained, and consider limitations on the movement of people and loads.

1.2.4 SPINAL ANATOMY AND POSTURE

The World Health Organization has defined a work-related disorder as one that results from a number of factors, and where the work environment and the performance of the work contribute signi cantly, but in varying magnitude, to the causation of the disease. The term musculoskeletal disorder denotes health problems of the locomotor apparatus, i.e. muscles, tendons, the skeleton, cartilage, the vascular system, ligaments and nerves.

So, work-related musculoskeletal (MSDs) disorders include all musculoskeletal disorders that are induced or aggravated by work and the circumstances of its performance.

MSDs cover a wide range of in ammatory and degenerative diseases of the locomotor system. They include:

- In ammations of tendons (tendinitis and tenosynovitis), especially in the forearm wrist, elbow and shoulder, evident in occupations involving prolonged periods of repetitive and static work;
- Myalgias, i.e. pain and functional impairments of muscles, occurring predominantly in the shoulder-neck region, that occur in occupations with large static work demands;
- Compression of nerves – entrapment syndromes – occurring especially in the wrist and forearm;
- Degenerative disorders occurring in the spine, usually in the neck or lower back, especially in those performing manual handling or heavy physical work. However, they may also occur in the hip or knee joints.

These disorders are chronic, and symptoms usually occur only after exposure to work related risk factors for a period of time.

There is little evidence of the use of standardised diagnostic criteria for MSDs across Member States of the European Union, and a range of terms have been used in di erent countries to describe these disorders. For example, when they affect the upper limbs, the terms include Repetitive Strain Injuries (RSI), Work-Related Upper Limb Disorders (WRULDs), Troubles Musculo-Squelettiques (TMS) and Cumulative Trauma Disorders (CTD).

Manual handling involves muscular work. There are two main types of muscular work:

static work: when maintaining a posture (holding the body or part of the body in a fixed position), certain skeletal muscles remain contracted

dynamic work: when moving body parts, active skeletal muscles contract and relax rhythmically. The difference between these two types is shown in the following example: when you carry boxes, your arm muscles perform static work in holding the boxes, while your leg muscles carry out dynamic work in walking. Static as well as dynamic work can cause fatigue and lead to injuries. Manual handling should therefore be carried out as much as possible in a neutral posture. Posture is the position of your body (including your arms and legs) while you are working. You're working in a bad (constrained, awkward or poor) posture when your joints must be held beyond their comfortable, neutral position, and close to the extreme end of their maximum range of movement. In a constrained posture muscles can produce less force than in a more extended, comfortable one. This means that muscles will get tired faster in awkward postures, even when the work activity does not require high muscle forces. Also, the mechanical load on the spine and joints is higher in these postures than in comfortable ones.

1.2.5 PLANNING LIFTS

There are several factors that make manual handling hazardous, and increase the risk of injury. These are called risk factors. The risk factors, particularly for back injury, are related to four aspects of manual handling: the load, the task, the environment and the individual.

1.2.5.1 The load

The risk of back injury increases during lifting, carrying, pushing and pulling of loads, if the load is:

- Too heavy: There is no exact weight limit for manual handling. A weight of 20 to 25 kg is heavy to lift for most people, especially if the load is handled several times in an hour. Note that pushing or pulling often imposes less loading on the body than lifting or carrying.
- Too large: One basic rule for lifting and carrying is to keep the load as close to the body as possible. In order to get a broad load close to the body, the worker has to open the arms to reach and hold the load. The arm muscles cannot produce force when reaching as effectively as with the arms held in close. Thus, the muscles will get tired more rapidly when handling a large bulky load.
- Difficult to grasp: Loads that are difficult to grasp can result in the object slipping, causing sudden movement of the load. Gloves usually make grasping more difficult than with bare hands. Providing the objects with handles or using aids for gripping (e.g. when carrying plate material) reduces the load on the worker. Loads with sharp edges or of dangerous materials (solids or liquids) can injure workers, especially in the event of a collision.
- Unbalanced, unstable or if the contents can move: With unbalanced objects, it is difficult to hold the centre of gravity of the load close to the middle of the body. This leads to uneven loading of muscles, and fatigue. Unstable or moving content, such as a liquid, causes uneven loading of the muscles and sudden movements of the load can make workers lose their balance and fall.
- Difficult to reach: Loads that can only be reached with outstretched arms, or by bending or twisting the trunk, require more muscular force. The spine may easily be hurt if the trunk is bent or twisted while lifting.

1.2.5.2 The task

The risk of back injury increases if the task:

- Is too strenuous: Tasks may be very demanding if they have to be carried out too frequently or for too long with insufficient rest or recovery time (e.g. continuous lifting or carrying for long distances, or activities where the working speed is imposed by a process which cannot be altered by the worker).

- Involves awkward postures or movements: Working with a bent and/or twisted trunk, raised arms, bent wrists, a bent neck and turned head increases the risk of back injury and should be avoided, as should twisting, turning and bending movements of the trunk, overreaching, sudden movements and repetitive handling.

1.2.5.3 The environment

The following characteristics of the work environment may increase the risk of back injury:

- Space available: A lack of space to carry out manual handling may lead to inappropriate body postures and dangerous imbalance in the loads.
- Floor: Handling loads on different working levels or on floors that are slippery, uneven or unstable (such as working platforms or fishing boats) may increase the risk of accidents and back injury.
- Climate: The physical climate (temperature, humidity and ventilation) may affect the risk of back injury. Heat makes you feel tired, and sweat makes it hard to hold tools, requiring more force. Cold can make your hands numb, making it hard to grip.
- Lighting: Insufficient lighting may increase the risk of accidents when handling loads. It may also make you work in awkward positions to see clearly what you are doing.

1.2.5.4 The individual

There are also some individual factors that can influence the risk of back injury:

- Experience, training and familiarity with the job (for example, new episodes of low back pain are common in the first year of employment);
- Age (the risk of low back disorders increases with the number of years at work: the first episode of low back pain occurs in most people by the age of 30)
- Physical dimensions and capacity (length, weight, strength, etc.)
- Personal lifestyle (smoking may, for example, increase the risk of low back disorders)
- History of back disorders (this is a predictor of future back injuries)

Willingness to use personal protective equipment (for example, clothing and footwear).

1.2.6 RISK CONTROL AND LIFTING TECHNIQUES

A risk assessment is a careful examination of what in the work could cause harm to people. It can then be decided whether sufficient precautions have been taken, or whether it is necessary to do more to prevent harm. The challenge is to eliminate, or at least reduce, the potential for accidents, injury or ill health that arise from working activities and tasks. Simple steps can be followed to carry out an effective risk assessment in the workplace:

- Look for the hazards that could cause accidents, injuries or ill health, taking into account the load, the task, the environment and the operator
- Decide who might be harmed and how: evaluate the potential consequences of the hazards
- Decide whether the existing precautions are adequate or whether more should be done: find ways to reduce the risk
- Monitor the risks, and review preventive measures.

Prevention measures

The negative health effects of manual handling can be prevented by trying to eliminate or at least reduce the risk factors involved. The following hierarchy of prevention measures should be used:

Elimination

First, can the work be designed and organised in such a way that manual handling can be avoided completely, or at least restricted (e.g. using powered or mechanical handling equipment such as conveyor belts, lift trucks, electric hoists or gravity-inclined roller track)?

Technical measures

If manual handling cannot be avoided, automation, mechanisation and the use of lifting and transport equipment should be considered.

However, attention should be paid to ensure that new work risks are not created (e.g. through noise, or hand-arm vibration).

Organisational measures

Organisational or administrative measures should only be considered if elimination of manual handling is not possible, and if technical measures are not effective in reducing the risks involved in manual handling. Heavy or frequent manual handling tasks should be carried out by several people or, if possible, the amount that is handled should be reduced or the load split into smaller ones.

The rate of manual handling should not be set by a machine, supervisor or colleagues. The time taken to carry out manual handling tasks should be extended by taking breaks, or by alternating them with other tasks so that the muscles have time to recover.

Provide information and training to workers

If workers have to carry out manual handling activities, they should be informed of the risks of accidents and ill health, particularly concerning their specific tasks. They should also receive training on the use of equipment and on correct handling techniques

Correct handling techniques Lifting

Before lifting the load, you should plan and prepare for the task. Make sure that:

- You know where you are going The area around the load is clear of obstacles
- Doors are open and there is nothing on the floor that could trip someone or make them slip
- You have a good grip on the load
- Your hands, the load and any handles are not slippery
- If you are lifting with someone else, both of you know what you are doing before you start
- You should adopt the following technique when lifting the load:
- Put your feet around the load and your body over it (if this is not feasible, try to keep your body as close possible to the load and in front of it)
- Use the muscles of your legs when lifting
- Keep your back straight
- Pull the load as close as possible to your body
- Lift and carry the load with straight arms.

Pushing and pulling

Pushing and pulling handling devices such as trolleys and barrows is particularly strenuous for the back, shoulders and arms. It is important that:

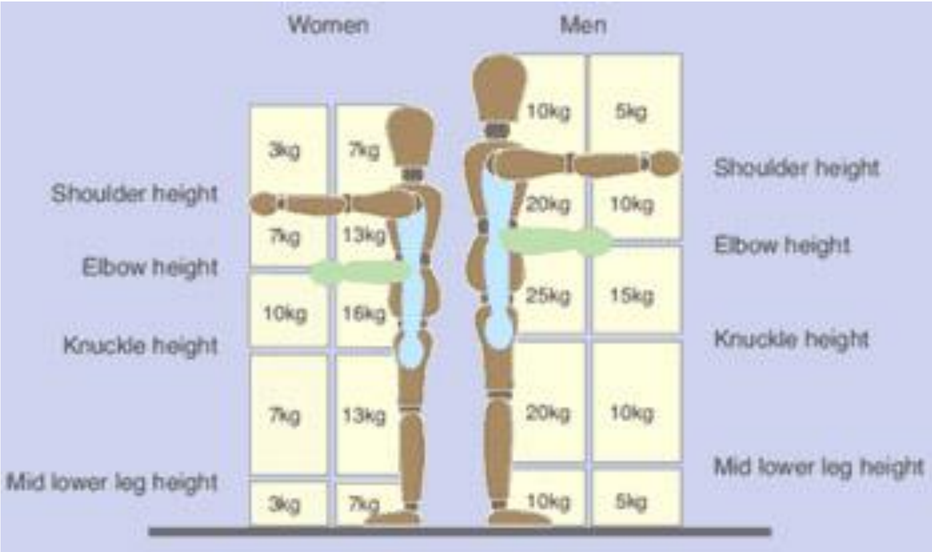
- Pushing and pulling is done using the body's own weight: when pushing you should lean forward, when pulling you should lean backward
- You have enough grip on the floor in order to lean forward/backward
- You avoid twisting, turning and bending the back
- Handling devices have handles/hand grips that you can use to exert force. Handle height should be between the shoulder and waist so that you can push/pull in a good, neutral posture
- Handling devices are well-maintained so that the wheels run smoothly

The chart below gives guideline weights for lifting and lowering, which assumes that the handling is taking place in reasonable working conditions with a load that is easily grasped with both hands by a reasonably fit, well-trained individual.

No manual handling activity is completely safe. However, using these guidelines as part of a well thought out risk assessment will reduce the risks from manual handling activities.

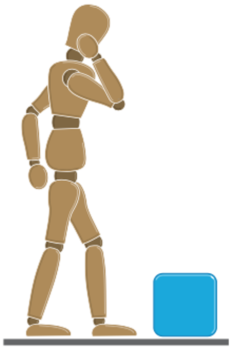
Weights to be lifted may need to be reduced below the guideline values if there are environmental or other factors that could have an adverse effect on the activity or if it involves twisting or bending.

Similarly, if the task is being carried out frequently then weights should be reduced.



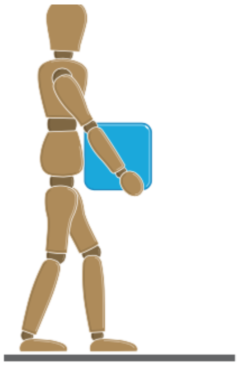
Good handling technique for lifting

Here are some practical tips, suitable for use in training people in safe manual handling.



Think before lifting/handling. Plan the lift. Can handling aids be used? Where is the load going to be placed? Will help be needed with the load? Remove obstructions such as discarded wrapping materials. For a long lift, consider resting the load midway on a table or bench to change grip.

Adopt a stable position. The feet should be apart with one leg slightly forward to maintain balance (alongside the load, if it is on the ground). The worker should be prepared to move their feet during the lift to maintain their stability. Avoid tight clothing or unsuitable footwear, which may make this difficult.

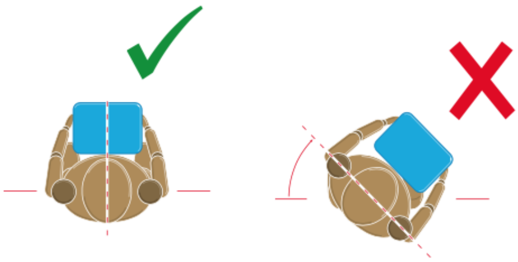


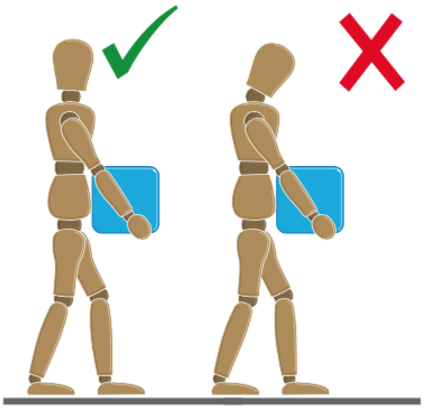
Get a good hold. Where possible, the load should be hugged as close as possible to the body. This may be better than gripping it tightly with hands only.

Start in a good posture. At the start of the lift, slight bending of the back, hips and knees is preferable to fully flexing the back (stooping) or fully flexing the hips and knees (squatting).

Don't flex the back any further while lifting. This can happen if the legs begin to straighten before starting to raise the load.

Keep the load close to the waist. Keep the load close to the body for as long as possible while lifting. Keep the heaviest side of the load next to the body. If a close approach to the load is not possible, try to slide it towards the body before attempting to lift it.





Avoid twisting the back or leaning sideways, especially while the back is bent. Shoulders should be kept level and facing in the same direction as the hips. Turning by moving the feet is better than twisting and lifting at the same time.

Keep the head up when handling. Look ahead, not down at the load, once it has been held securely.

Move smoothly. The load should not be jerked or snatched as this can make it harder to keep control and can increase the risk of injury.

1.2.7 BEHAVIOURAL SAFETY

Safe behavior has an important place within the overall management of health and safety: any risk control measures that rely on procedures being followed, or PPE being used, will only be fully effective if they are understood and complied with by all of the people involved. It should be noted that procedural measures and PPE are at the lower levels of the hierarchy of risk reduction, so while safe behavior increases the effectiveness of these measures, it is not a substitute for the adoption of measures that are higher on the hierarchy, particularly where a human error could have serious consequences.

Figures are often quoted indicating that human behavior is a contributory factor in 70-80% of accidents, however, this does not mean that behavior is the only reason for the accident, or that only the behavior of front-line personnel should be considered. Any programmes to improve safety by means of behavior modification should form part of a range of measures to address human factors and the safety culture of an organization.

Behavioral safety programmes typically involve workplace observation of behavior and conditions, supported by follow-up work to resolve identified issues, and a reporting system, in order to address the different types of human failure. Programmes should also involve observation of, and positive feedback on, safe practices in order to identify and be able to disseminate and reinforce safe behaviour. The success of such a programme will be strongly influenced by an organization's culture: if a programme involves observing and giving feedback, the willingness to do so will depend on safety improvement being a shared objective that transcends hierarchical and workgroup boundaries.

Both deliberate deviations and errors can be reduced by identifying and addressing underlying causes, variously referred to as "Performance Influencing Factors" or "antecedents" of behaviour, together with increasing the awareness of the consequences of deviations and errors. Performance Influencing Factors are wide ranging, and can include organisational and management arrangements, contractual incentives, and the working environment:

- Errors are particularly likely if the design of operations leads to high levels of distraction, for example, if the person supervising a task is also operating complex equipment that is critical to the safe execution of the task;

- Deviations are most likely in cases where the design of the equipment and task make it inconvenient to operate in the correct way, for example, if a point of isolation is not readily accessible, then this can introduce the temptation to use other, less reliable, means of stopping equipment.

Behavioural safety programmes can be effective in reducing the frequency of low-severity personal injuries, but have less impact on reducing incidents that result from technical failures or inadequacies in procedures, which can lead to accidents with high potential severity. The precursors of high severity accidents may differ from those of more minor incidents, hence different management approaches are required. Prior to embarking on a behavioural safety improvement programme, an organisation should ensure that:

- Risk assessments have been undertaken, in order to:
  - ✓ Identify hazards;
  - ✓ Apply the hierarchy of controls to reduce risk; and o
  - ✓ Identify where the control of residual risks relies on correct behaviours being adopted;
- Suitable and effective operating procedures are in place, including those for response to abnormal / emergency situations;
  - ✓ This will be supported by establishing a culture where, if an employee judges a procedure to be incorrect, they are required to stop the task, and seek clarification / revision, rather than ignoring / deviating from the procedure; and
  - ✓ Implementation of the procedures will need a combination of training and supervision in order to develop competence;
- There is adequate resourcing to:
  - ✓ Respond to safety concerns identified by the workforce;
  - ✓ Implement lessons learned from site / corporate / industry experience; and
  - ✓ Keep safety management systems and risk control measures relevant and up to date.

These preparatory measures help to ensure that the behavioral safety programme can focus on true behavioral issues, and is not attempting to compensate for systemic weaknesses in the organization’s safety culture and risk management.

GWO BST FIRE AWARENESS

1.3.1 Introduction

Fires present a range of risks to people and assets, and are particularly challenging in high structures such as WTGs. In general, a fire requires the presence of:

- Fuel, which can be any combustible material;
- Oxygen, generally from air; and
- A source of ignition such as heat, a spark or flame.

If any of these is absent, then the chemical reactions that constitute a fire cannot be initiated or sustained. The priority is to protect people, through a combination of technical and procedural systems for avoiding initiation of fires, fire detection, suppression (extinguishing) and containment, and by ensuring that people can escape in an emergency.

As WTGs are usually unmanned, fire suppression may consist of:

- Automatic systems, to protect the asset, and minimize the risk of secondary fires starting on surrounding land; and
- Manual fire-fighting equipment, to extinguish a small fire and / or safeguard an escape route.

Fire suppression systems that protect the asset can both protect people and introduce additional risks:

- An effective fire protection system will minimize the need for fire remediation work to be undertaken, thereby reducing potential future risk exposure; however
- Some fire extinguishing media are hazardous to people; and
- The maintenance requirements of the fire protection system should be considered, to minimize the risks to which they will expose people;

In addition to fires that originate within WTGs, wind farms can also be affected by other fires on the site, such as heath, moor or forest fires, which can present a direct risk to people working on the site, as well as having the potential to damage equipment and impede site access / egress.

1.3.2 Legislation

The principal regulations are the Regulatory; these impose more specific duties than the HSWA in the general fire safety matters that they regulate. The regulations define similar duties relating to general fire safety, including a duty on employers (or others in control of workplaces) to:

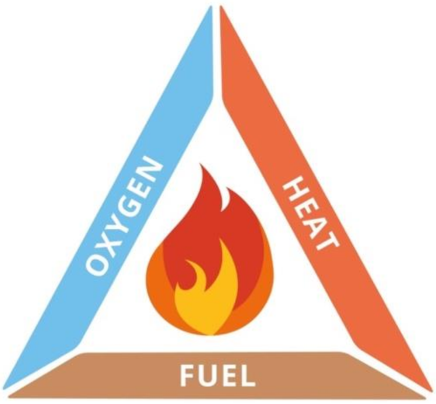
- Ensure the safety of people with respect to fire in the workplace; and
- Carry out a fire risk assessment, and implement the measures identified in it to protect people in the workplace.

General fire safety includes measures to reduce the risk of fire occurring, and if one does occur, to:

- Minimise its spread;
- Ensure that people can escape;
- Have the means to fight the fire;
- Detect the fire and warn people;
- Have arrangements in place for the actions to be taken, and ensure that employees have been trained / instructed; and
- Mitigate the effects of fire.

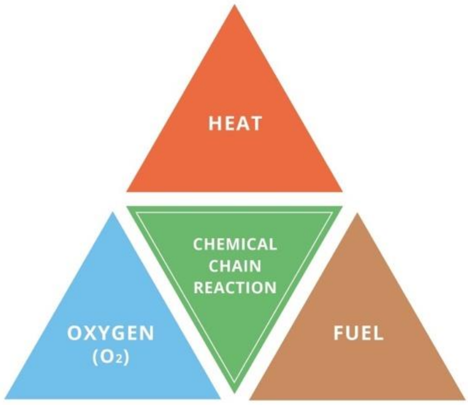
The regulations also establish local fire authorities, which as well as operating fire and rescue services, are the enforcing authorities for fire safety measures under the regulations, and may undertake compliance checks on wind farms. Building regulations contain detailed design requirements for fire safety, however they do not apply to buildings "*into which people go only intermittently and then only for the purpose of inspecting or maintaining fixed plant or machinery*", so would not apply to a substation or WTG. Certain small detached buildings, with a floor area not exceeding $30m^2$, are also exempt. While such buildings are exempt, the regulations and associated Approved Documents can still be used as a basis for good design.

1.3.3 Fire combustion and fire spread



For many years the concept of fire was symbolized by the Triangle of Combustion and represented, fuel, heat, and oxygen. Further fire research determined that a fourth element, a chemical chain reaction, was a necessary component of fire. The fire triangle was changed to a fire tetrahedron to reflect this fourth element. A tetrahedron can be described as a pyramid which is a solid having four plane faces. Essentially all four elements must be present for fire to occur, fuel, heat, oxygen, and a chemical chain reaction. Removal of any one of these essential elements will result in the fire being extinguished.

The four elements are oxygen to sustain combustion, sufficient heat to raise the material to its ignition temperature, fuel or combustible material and subsequently an exothermic chemical chain reaction in the material. Each of the four sides of the fire tetrahedron symbolise the Fuel, Heat, Oxygen and Chemical Chain Reaction. Theoretically, fire extinguishers put out fire by taking away one or more elements of the fire tetrahedron.



The symbol although simplistic, is a good analogy, how to theoretically extinguish a fire, by creating a barrier using foam for instance and prevent oxygen getting to the fire. By applying water you can lower the temperature below the ignition temperature or in a flammable liquid fire by removing or diverting the fuel. Finally interfering with the chemical chain reaction by mopping up the free radicals in the chemical reaction using, BCF and other halon extinguishers, it also creates an inert gas barrier. However this type of extinguisher is being phased out and in the future other extinguishing agents may be found using this principle.

1.3.3.1 DEFINITION OF FIRE

One generally accepted definition of combustion or fire, is “a process involving rapid oxidation at elevated temperatures accompanied by the evolution of heated gaseous products of combustion, and the emission of visible and invisible radiation.”

The combustion process is usually associated with the oxidation of a fuel in the presence of oxygen with the emission of heat and light. Oxidation, in the strict chemical sense, means the loss of electrons. For an oxidation reaction to occur, a reducing agent the fuel, and an oxidizing agent, usually oxygen must be present. As heat is added, the ignition source, the fuel molecules and oxygen molecules gain energy and become active. This molecular energy is transferred to other fuel and oxygen molecules which creates a chain reaction. A reaction takes place where the fuel looses electrons and the oxygen gains electrons. This exothermic electron transfer emits heat and/or light.

1.3.3.2 THE COMBUSTION MODES

The combustion process occurs in two modes:

- The flaming
- The non flaming, smoldering or glowing embers.

For the flaming mode it is necessary for solid and liquid fuels to be vaporized. The solid fuel vapors are thermally driven off, or distilled and the liquid fuel vapors evaporated. It is this volatile vapor from the solid or liquid fuels that we see actually burning in the flaming mode. This gas or vapor production, emitted from the fuel is referred to as pyrolysis. Once a flame has been established, heat transfer from the flame to the fuel surface continues to drive off more volatile gases and perpetuates the combustion process. For continued burning in the flaming mode requires a high burning rate, and the heat loss associated with transfer of heat from the flame area by conduction, convection, and radiation must be less than the energy output of the fire. If the heat loss is greater than the energy output of the fire the fire will extinguish.

Both modes, flaming and non flaming surface modes, can occur singly, or in combination. Flammable liquids and gases only burn in the flaming mode. Wood, straw, and coal are examples where both modes may exist simultaneously.

Flaming combustion can occur in the following forms:

- Premixed flames where the fuel and oxygen are mixed prior to ignition. For example the flame on a bunsen burner, gas stove, or propane torch.
- Diffusion flames, more common, where the fuel and oxygen are initially separate but burn in the region where they mix, like a burning of a pool of flammable liquid or the burning of a log.

1.3.3.3 STAGES OF A FIRE

There are three generally recognized stages to a fire:

- The incipient stage
- smoldering stage
- flame stage

The incipient stage is a region where preheating, distillation and slow pyrolysis are in progress. Gas and sub-micron particles are generated and transported away from the source by diffusion, air movement, and weak convection movement, produced by the buoyancy of the products of pyrolysis.

The smoldering stage is a region of fully developed pyrolysis that begins with ignition and includes the initial stage of combustion. Invisible aerosol and visible smoke particles are generated and transported away from the source by moderate convection patterns and background air movement.

The flaming stage is a region of rapid reaction that covers the period of initial occurrence of flame to a fully developed fire. Heat transfer from the fire occurs predominantly from radiation and convection from the flame.

1.3.3.4 CLASSES OF FIRE

Combustible and flammable fuels involved in fires have been broken down into five categories:

- Class A fires – are fires involving organic solids like paper, wood, Esc
- Class B fires – are fires involving flammable Liquids
- Class C fires – are fires involving flammable Gasses
- Class D fires – are fires involving Metals
- Class F fires – are fires involving Cooking oils.

A fire begins by an external ignition source in the form of a flame, spark, or hot ember. This external ignition source heats the fuel in the presence of oxygen. As the fuel and oxygen are heated, molecular activity increases. If sufficiently heated, a self-sustaining chemical chain reaction or molecular activity occurs between the fuel and oxygen. This will continue the heating process and the resulting chain reaction will escalate without the need for an external ignition source. Once ignition has occurred, it will continue until

- all the available fuel or oxidant has been consumed or
- the fuel and/or oxygen is removed or
- by reducing the temperature by cooling, or
- by reducing the number of excited molecules and breaking the chain reaction.

1.3.4 Fire extinguishing

In the event of a fire, it is essential that all personnel know what to do; this is achieved by a combination of training, practice drills, and provision of information. Training will typically include fire detection, arrangements for firefighting, communication, team roles, escape / evacuation and assembly arrangements. Clear information should be displayed at the entrance points of buildings and WTGs, so that personnel are informed about:

- Fire protection systems, and instructions on their operation;
- Means of summoning help in the event of a fire or other emergency;
- Types, usage, limitations and locations of manual fire extinguishers; and
- Any automatic fire extinguishing systems, including any risks that they present to people, steps to be taken to control these risks, and clear indication of the status of such systems.

Emergency escape routes should be indicated, and kept clear at all times. The time needed for emergency escape from challenging locations such as the lift or the hub should be assessed, through exercises, to ensure that the fire protection measures provide sufficient time for people to escape, taking account of the maximum number of people permitted to be in the WTG. Fire escape routes should be protected against the effects of fire in adjacent locations that house high risk items, such as transformers, switchgear and combustible materials; EN 50308:2004 specifies that escape routes that involve climbing shall maintain their function for at least 30 minutes in the event of a fire.

In the event of fire in a WTG, escape from the nacelle would either be down the tower, or, if the fire / smoke is affecting the tower, by external descent. The risks involved in emergency escape from the nacelle should be assessed, for example:

- Opening hatches on the nacelle, either to dissipate smoke or enable evacuation, may intensify the fire due to the chimney effect in the tower; the risk of this occurring will depend on the location of the fire and the available routes for air flow;
- the position of the nacelle hatches should be considered, in relation to equipment that could initiate or sustain a fire, and potentially hinder use of this evacuation route;
- the descent energy rating of emergency descenders should be suitable for the maximum number of people who may be present in the WTG, and the height of descent;
- the time that will be taken for the maximum permitted number of personnel in the WTG to escape using the descender should be assessed, and compared with the potential rate of spread of smoke and fire, to ensure that there is adequate provision for escape in the event of a fire.

The precise arrangements to mitigate these risks are likely to be site-specific, taking account of the WTG design and fire detection and suppression systems.

In the event of a fire, it is essential that all personnel on a site can be accounted for; this is enabled by having accurate records of who is on a site on a particular day, and where they are working.

An established fire in a WTG or substation will generally be beyond the capability of site teams and fire-extinguishing equipment, and will require support from public fire and rescue services. Site Emergency Response Plans should include response to major fires; considerations include:

- Realistic response times and capabilities of fire and rescue services, noting that the first line of response in many remote areas is provided by retained firefighters, with a more limited remit than full-time teams;
- Measures that have to be taken before firefighting can commence, such as isolation and earthing of HV electrical systems, and how this will be communicated to the fire service;
- Limitations on the use of site roads by emergency vehicles;
- Ensuring that the fire and rescue service have accurate site maps – ideally provided in a digital format that can be uploaded into emergency vehicle global positioning systems (GPS);
- Availability of water – especially in dry conditions, in which heaths, moors and forests are particularly vulnerable to fire; and
- Liaison with landowners and adjacent land managers, such as forestry staff and farmers.

Due to the height of most WTGs, fire and rescue services cannot be expected to extinguish fires in nacelles; their priority will generally be to work at ground level to protect people and property from the effects of the fire, such as avoiding burning debris leading to secondary fires becoming established. Depending on the demands on the fire and rescue service at the time of a call, the response may come from a number of different fire stations, so it cannot be assumed that firefighters attending a site would have been there before; early engagement with local fire and rescue services can ensure that robust arrangements are in place, with information available to all firefighters who might attend a site. Any fire in a WTG is likely to be highly visible, and will attract attention; ERPs should include measures to manage such interest, including ensuring that onlookers are not putting themselves at risk or hindering emergency access, and being prepared to communicate effectively with local communities and the press. Lessons learned should also be shared across the industry, to minimise the risk of similar occurrences in future.

Once the fire has been extinguished, a range of follow-up actions may be necessary, such as:

- Establishing an exclusion zone, if the integrity of a WTG has been affected; and
- Clearing debris from the site; Once the immediate risks have been addressed, planning for repair or removal of the WTG can progress.

1.3.5 Fire prevention

Safe systems of work should ensure proper control of hot work that can introduce a source of ignition, such as welding or grinding; control measures could include the use of welding drapes to prevent sparks from landing on combustible surfaces, and ensuring that personnel and materials are available to extinguish any fire immediately.

Site rules should ensure that:

- Flammable substances are stored and used in a suitable manner; and
- Smoking is only allowed in designated areas; smoking should not take place inside site buildings, vehicles or WTGs, or near vegetated areas.

High standards of housekeeping avoid the build-up of combustible materials, whether on a site or in a WTG; good maintenance should also ensure that any leaks are repaired in a timely manner. Effective inspection and condition monitoring programmes can reduce the risk of components overheating, for example by carrying out periodic visual or thermographic inspection of electrical terminations, and monitoring temperatures of mechanical components such as bearings and brakes. The development of wind farm access roads can encourage public access into upland or forest areas, potentially increasing the risk of a fire starting on the ground; signage could be erected to provide warnings at times when the fire risk is highest, and to provide site emergency contact numbers for use if a member of the public observes a fire.

The commissioning plan should ensure that fire protection systems are installed and commissioned sufficiently early that they are available to protect people involved in subsequent commissioning work.

Thorough inspection and testing of electrical systems prior to being powered up can reduce the risk of fires starting as a consequence of poor termination or short circuits, however, task risk assessments should still determine whether further precautions are needed, in order to minimise the risk to people from such faults; these could include measures such as remote operation of switchgear (provided that the design enables this), establishing exclusion zones around equipment that is being made live, and ensuring that panel doors are kept closed.

If fire suppression systems introduce a risk to people, such as from the use of asphyxiant gases, then they will need to be isolated when maintenance tasks expose people to this risk, thereby disabling the protective system, and requiring it to be de-isolated on completion of the task; the design should ensure that system status is clearly indicated, to minimise the probability of it being left in the wrong state. Where systems that do not introduce such hazards can be used, the protection of the asset can be continuous, and may also help to protect people while they are in attendance.

Fire extinguishers are generally only suitable for extinguishing small fires, or to safeguard an escape route. They should be provided in regular working areas, such as the tower entrance and nacelle. Their selection and use should ensure that they do not endanger people, if used in a restricted space such as the nacelle of a WTG. Their lifetime maintenance requirements should also be considered, to minimise the need for specialist inspections.

1.3.6 Firefighting equipment in a WTG

For the purpose of effective fire protection of wind turbines, automatic, stationary fire extinguishing systems shall be installed. Gas extinguishing systems as well as fine water spray systems are suitable (taking into account the special conditions given and the personal safety for the staff). These fire extinguishing systems can be used as installation- or room protection systems or as a combination of both. Installation protection systems have a selective effect on the device or component to be protected.

Before the fire extinguishing system is activated, the air-conditioning or ventilation system must be switched off automatically.

With respect to the application at wind turbines, extinguishing agents that are as residue-free, non-corrosive and non-electro conductive as possible, and which are suitable with respect to the prevalent environmental conditions at wind turbines (temperature, weather, impermeability of the installations and rooms to be protected) and the fire loads would be desirable. The following systems can be applied at wind turbines, depending on the intended type of application:

- Carbon dioxide (CO2) fire extinguishing systems

- Inert gas extinguishing systems
- Fine water spray systems (water mist systems)
- Water spray systems (transformer and electric power substation, respectively).

Foam extinguishing systems can be used with every allowed kind of foam expansion.

Powder extinguishing systems as well as aerosol extinguishing systems cannot be recommended for application at wind turbines since they may cause consequential loss.

Suitability of automatic fire extinguishing systems for the purpose of room and installation protection is to be reviewed for each individual turbine by taking into account the respective operating conditions at the wind turbine and by consulting with the manufacturer. The following aspects, in particular, have to be taken into account:

- Effectiveness of extinguishing
  - ✓ Required extinguishing gas concentration and impingement of water, respectively
  - ✓ Application(residence)time for gas extinguishing systems (taking nto account possible reignition)
  - ✓ Operating time of water extinguishing systems (taking into account an effective extinguishing success)
  - ✓ Impermeability of the room/pressure relief
- Storing of extinguishing agents (required quantity, weight, etc.)
- volume/Required space
- Installation/Approval, implementation
- Maintenance
- Reliability (robustness of the systems with respect to susceptibility to failure in order to limit maintenance and inspection intervals)
- Cost

In order to ensure the effectiveness of gas extinguishing systems it is necessary to pay special attention to the planning requirements in connection with the pressure relief openings that will have to be provided. Moreover, attention should be paid to the required protection regulations with respect to the safety of persons when applying gas extinguishing systems.

Each extinguishing system has certain limits of applicability or advantages and disadvantages, respectively. Therefore, the suitability of the chosen extinguishing system has to be reviewed for each individual application because of the large number of possible parameters and the given conditions that are to be adhered to in order to ensure the effectiveness of extinguishing.

Fire detection, alarm, alarm control, triggering of a fire extinguishing system and its monitoring is usually done by a fire detection system approved for this purpose.

FIRE EXTINGUISHERS

In order to fight initial fires it is necessary to provide a sufficient number of appropriate and operational fire extinguishers in accordance with national standards. They shall be available in all rooms in which a fire may occur, amongst others in the nacelle, in the tower base and in the electric power substation which might be arranged externally.

The extinguishing agent is to be adjusted to the existing fire loads. Due to the negative impacts of extinguishing powder on electrical and electronic equipment it is recommended to refrain from using powder extinguishers if possible.

At least in minimum one 5 kg CO2 fire extinguisher and one 9 l foam fire extinguisher must be installed in the nacelle (pay attention to the risk of frost). And at least in minimum one 5 kg CO2 fire extinguisher must be installed at the intermediate levels and at the tower base in the area of the electrical installations each.

Fire extinguishers have to be inspected by an expert at regular intervals, at least every two years. In case the extinguisher is subject to high stress, e.g., due to environmental impacts, shorter time intervals might be required as determined by a risk assessment.

GWO BST WORKING AT HEIGHTS

1.4.1 Introduction

A place is considered to be "at height" if a person could be injured by falling from it; this means that work at height may occur in a wide range of situations, such as:

- Climbing ladders on WTG towers or met masts;
- Working in a nacelle, from which there might not normally be a risk of falling, unless hatches were open or a major component had been removed;
- Inspecting WTG blades, using a Mobile Elevating Work Platform (MEWP), suspended access or rope access techniques;
- Working from a scaffold to run cables within a site building; or
- Unloading components from a LGV trailer.

Work at height can expose people to a range of hazards, including:

- Falls from height can result in severe injury or death, and are the biggest single cause of workplace fatalities;
- If people are beneath work being carried out at height, then falling objects present a hazard;
- If a person is suspended in an upright position for a period of time, as may occur after a fall has been arrested, suspension intolerance or syncope may lead to loss of consciousness;

If a person is incapacitated, as a result of becoming ill or being injured in a workplace that is at height, then they may need to be rescued by others with suitable training, competence and work equipment, before medical help can be provided, potentially delaying treatment of their initial condition.

1.4.2 Legislation

The Work at Height Regulations require employers to assess the risks of work at height, and, so far as is reasonably practicable, take steps to avoid those risks, according to a clear hierarchy of protective measures:

1. Avoid work at height;
2. Utilise an existing safe place of work;
3. Where work at height cannot be avoided, use work equipment or other methods to prevent falls from occurring;
4. Where the risk of falls cannot be eliminated, take suitable measures to minimise the distance and consequences of a fall;
5. Where it is not reasonably practicable to minimise the distance of a fall, the consequences of a fall should still be mitigated; and
6. Mitigate residual risk through procedural means such as training, instructions, inspection programmes, warnings to keep people away from locations where falls can occur, good housekeeping and provision of suitable footwear etc.

A decision to rely on protective measures from a lower level on the hierarchy is only justifiable if it is not reasonably practicable to adopt a higher (preferred) level of protection. At every level of the hierarchy, collective protection should take precedence over personal protection; for example, a guardrail is a more reliable means of fall prevention than relying on work restraint, which is only effective if consistently and correctly used by every individual.

Work at height should only take place in weather conditions that do not jeopardise the health and safety of workers, considering factors such as task-specific limits of wind speed, temperature and precipitation; if lightning is expected, then work in or on tall structures such as WTGs, met masts and cranes should not take place.

Specific mandatory requirements relating to workplaces and work equipment are given in the following schedules to the regulations:

1. Places of work, and access and egress at height;

2. Guard rails, barriers and other collective means of protection;
3. Working platforms;
4. Collective safeguards for arresting falls;
5. Personal fall protection systems;
6. Ladders; and
7. Inspection reports.

1.4.3 Harness

Employees must have the following basic occupational safety equipment:

- Working suit;
- High safety shoes (class S3);
- Safety helmet;
- Safety gloves.

Depending on the task in hand, service employees also require:

- An additional light source for work in areas with poor lighting;
- For work on the hydraulic system and with hydraulic tools: Safety glasses;
- For noisy work in the tower or in the nacelle: Hearing protection;
- For switching actions in the medium-voltage range: Safety helmet with face protection, insulating gloves, insulating jacket, insulating mat

The personal protective equipment (PPE) against falls from a height must also be used for the ascent in the tower using the vertical ladder or the service lift, or while staying in a fall hazard area.

The Personal Protective Equipment against falls from a height consists of the following parts:

- 1 safety harness with chest or abdominal fall arrest lug and dorsal fall arrest lug;
- 1 lanyard with energy absorber as Y-rope or 2 separate lanyards with energy absorber;
- 1 fall arrester, permitted for use with the respective fall arrest system in the tower
- 1 adjustable safety rope
- 2 snap hooks with Trilock lock

- 1 hub rope

In EU member states, the PPE against falls from a height must comply with the standards EN 353 (safety harnesses), EN 353-1 (fall arrest systems) and EN 354 (lanyards).

1.4.3.1 SAFETY HARNESS

The safety harness has a either an abdominal or/and chest fall arrest lug.

The two lateral lugs of the abdominal strap can be used for an equipment bag.

The general procedures of the handling of the PPE against falls are the following, in any case personnel must observe manufacturer instructions.

- Attach the lanyard with energy absorber to the dorsal lug at the back plate of the safety harness using the small snap hook and secure it;
- Attach the large snap hooks to the lateral lugs on the left and right side;
- Put on the safety harness like a jacket;
- Pull the right chest strap through the chest lug and lock it into the buckle;
- Fasten the abdominal strap;
- Guide the leg straps through the legs from behind and lock them into the lateral buckles

- Pull all straps tight so that the safety harness fits tightly around the body.

1.4.4 Vertical Fall arrest lanyards

Wind Turbine can be equipped with different fall arrest systems:

- A fall arrest rail in the center of the vertical ladder
- A safety rope next to the vertical ladder
- A safety rope in the center of the vertical ladder (Latchways system)

Each of them have their own characteristics, but in any case the fall arrester must be connected directly to the abdominal lug of the safety harness.

1.4.4.1 SAFETY ROPE NEXT TO THE VERTICAL LADDER

- Completely loosen the knurled thumb screw on the fall arrester
- Push the ratchet down and open the fall arrester
- Place the open fall arrester around the safety rope
- Make sure that the fall arrester is in the correct mounting position
- Close the fall arrester so that the ratchet locks in place
- Manually retighten the knurled thumb screw
- Perform a functional test

1.4.4.2 FALL ARRESTER ON THE FALL ARREST RAIL

- The fall arrester with release mechanism from Haca can be attached and removed at any point on the fall arrest rail.
- Open the cover
- Push in the locking pin
- Pull the right half of the fall arrester to the side
- Attach the fall arrester to the fall arrest rail
- Carry out a suspension test

1.4.4.3 SAFETY ROPE IN THE CENTER OF THE VERTICAL LADDER (LATCHWAYS SYSTEM)

- Attach the fall arrester to the abdominal lug
- Use your right hand to hold the fall arrester in a hanging position, and use your thumb to operate the ratchet release mechanism
- Use your left hand to remove the left part of the fall arrester (starwheel) to the side
- Slide the fall arrester onto the rope, so that the rope runs through the inside of the housing
- Operate the ratchet release mechanism with your thumb and press both halves of the fall arrester together
- Check that the fall arrester is properly locked and can no longer be pulled apart
- Carry out a suspension test

1.4.4.4 ADJUSTABLE SAFETY ROPE

This further piece of safety equipment is required in order to secure the persone in awkward positions in case of a fall hazard. This also ensures to have both hands free for performing the necessary work.

The adjustable work-positioning lanyard is attached to the lateral lugs on the safety harness.

1.4.4.5 HUB ROPE

The hub rope is a fall arrester on a movable guide with flexible edge protection and a length of 10 m. It must be stored together with the webbing sling in an equipment bag.

1.4.4.6 LANYARD WITH ENERGY ABSORBER

The lanyard with energy absorber serves for safeguarding at a fixed attachment point, for example when there is a fall hazard during a change of location.

The lanyard with energy absorber has 2 large snap hooks for attaching to an attachment point, and 1 small snap hook for hooking into the dorsal lug on the back plate of the safety harness,

The energy absorber behind the small snap hook ensures that the fall of a person is arrested smoothly.

1.4.5 Emergency Procedures

In the event of accident the alarm must be raised quickly and correctly.

In the event of serious accident, life saving first aid must always be offered in preference to evacuation or waiting for the arrival of the doctor/rescue squad.

In the event of lesser injuries, where the patient is mobile, an effort must be made to use the normal ascent and descent methods, but the first-aider must be especially attentive.

In case of doubt, operate on the worst-case principle.

In the event of accidents in the tower, work on the principle of “always down and always inside”. However, this does not apply to rescue zone 1 (nacelle) in connection with horizontal evacuations.

In the event of an accident on a ladder or between two platforms, use the personal lowering equipment to lower to the nearest horizontal floor.

If a fire breaks out in the wind turbine, quickly report this to operating control room.

Fight the fire if possible, but operate on the principle, “Rescue persons rather than equipment”.

<u>IMPLEMENTATION OF EVACUATION</u>

Horizontal evacuation is used when the patient has an injury that could be life- threatening if the patient is evacuated vertically (fractured vertebra   shock).

The patient must lie in a horizontal position during the entire operation.

Vertical evacuation is used when the patient has an injury and is able to use the normal ascent and descent methods, either alone or with help, or when the patient may be lowered vertically from the nacelle or from the tower ladder.

Zone 1: Nacelle

Zone 2:

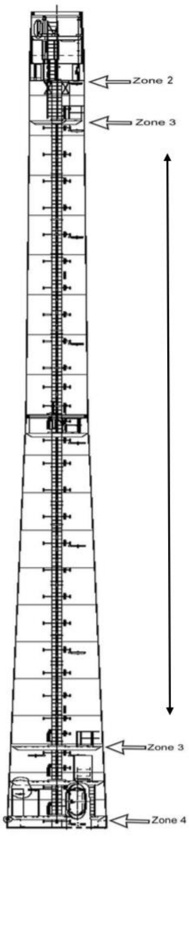
- Oscillation damper platform

Zone 3:

- Service lift top
- Resting and safety platform
- Platform

Zone 4:

- Tower/base



Evacuating Injured Personnel from Hub to Nacelle in Zone 1

1. Activate the emergency stop button and lock the rotor.
2. Pull out the person from inside the hub.
3. Attach an emergency descent device to the front of the full-body harness.
4. Attach the sling with the emergency descent device to one of the approved anchor points on the gearbox.
5. Turn the handle on the emergency descent device to pull out the person.

Figure 3-4: Device attached to front of full-body harness.

Figure 3-5: Attachment point on full-body harness.

Figure 3-6: Pulling out the person.

Figure 3-7: Pulling the person into the nacelle.

Evacuating Injured Personnel from Nacelle to Tower, Zone 1 to Zone 2

A descent should be carried out with great care and while using fall arrest equipment at all times.

An injured person can be lowered from the nacelle through the tower down to the base of the tower.

1. Activate the emergency stop button.
2. Attach the sling to the approved anchor point on the generator.
3. Attach the emergency descent device to the front of the full-body harness of the injured person.
4. Attach the emergency descent device to the approved anchor point on the generator with the sling.
5. Use the emergency descent device to hoist the person.
6. By hand, guide the injured person into place over the access way.
7. Lower the injured person to the yaw deck, controlling the speed with the emergency descent device.
8. Stabilize the injured person on the yaw deck.
9. Move the emergency descent device to the yaw deck.
10. Attach the emergency descent device to the bracket for the upper cable loop.
11. Guide the injured person through the access hole in the yaw deck to the service lift platform.
12. Stabilize the injured person on the platform.

Figure 4-1: Anchor point on the generator.

Figure 4-2: Emergency descent device attached to the sling.

Figure 4-3: Emergency descent device attached to front of full-body harness.

Figure 4-4: Person lowered to yaw deck.

Figure 4-5: Re-positioning the emergency descent device on yaw deck.

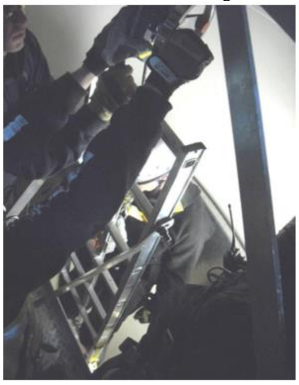


Figure 4-6: Guiding the injured person through access hole.

Horizontal Evacuation, Zone 3

1. Activate the emergency stop button.
2. Secure the injured person.
3. Lower the tiller rope through the shaft for the service lift.
4. Attach the emergency descent device and sling to the approved anchor points, which are placed on the tower flange.
5. Attach the emergency descent device to the injured person.
6. Position the injured person for lowering.
7. Lower the injured person down the shaft for the service lift while following down the ladder (if possible).

Figure 5-1: Emergency descent device attached to front of harness.

Figure 5-2: Emergency descent device and tiller rope.

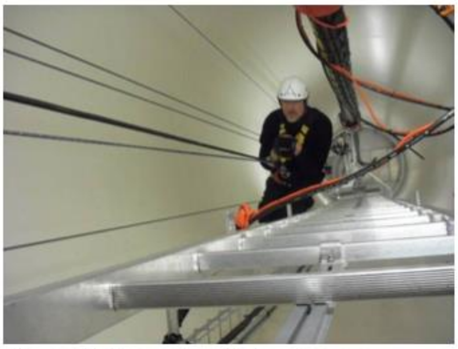


Figure 5-3: Lowering of injured person.

Evacuating Injured Personnel from Nacelle, Zone 1 to Ground (Outside Tower)

1. Activate the emergency stop button.
2. Prepare the emergency descent device.
3. Ensure that the full-body harness is properly secured to the approved anchor points before opening the hatch.
4. Wrap the sling around the beam to be used as an anchor point.
5. Attach the emergency descent device to the anchor point.
6. Attach the emergency descent device to the back of the full- body harness.
7. Open the hatch and position the person over the hatch.
8. Lower the injured person to the ground, controlling the speed with the emergency descent device.


Figure 6-1: Sling attached to beam.


Figure 6-2: Emergency descent device attached to back of full-body harness.


Figure 6-3: Lowering person through the hatch.

Horizontal Evacuation Using Stretcher, Zone 1

1. Activate the emergency stop button.
2. Lock the rotor.
3. Prepare the emergency descent device.
4. Make sure that the full-body harness is properly attached to the approved anchor points before opening the hatch.
5. Attach the emergency descent device to the fix point for descent equipment.
6. Mount the snatch block on the sling and attach the pulley wheel to the post for the member.
7. Lead the rope from the pulley wheel through the snatch block and then attach it to the stretcher.
8. Lower a guiding rope to the ground
9. Lift the stretcher slightly and open the bottom hatch. 10. Guide the stretcher out of the service hatch.

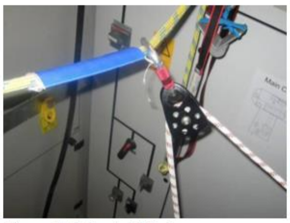


Figure 7-1: Snatch block.


Figure 7-2: Pulley wheel.

Figure 7-3: Descent rope.


Figure 7-4: Rope attached to stretcher.


Figure 7-5: Guiding rope.

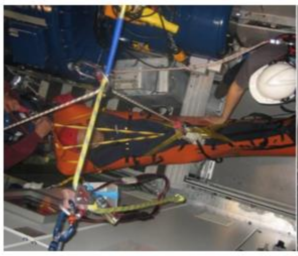


Figure 7-6: Guiding the stretcher out of the service hatch.


Figure 7-7: Lowering the stretcher.

1.4.6 PPE

There are specific, periodic inspection obligations for the turbine safety equipment, various safety devices and turbine components for all countries in which turbines are erected.

These inspections are not part of the standard maintenance work and must be performed by special experts.

The owner is responsible for organizing these inspections and for checking the proper and timely execution.

These special inspections apply to:

- the owner's PPE against falls from a height,
- the fall arrest system for the vertical ladder,
- the on-board crane,
- the fire extinguishers and, if available, the automatic fire alarm and fire extinguishing system,
- the first-aid kits.

Regarding the personnel before entering the turbine, they must check:

- all the PPE;
- the fall arrest system;
- Clamps;

The couple of employees entering the turbine also must perform a check on each other

1.4.7 Suspension Trauma

- Request an ambulance and helpers to receive the rappelled person on the ground
- Hook the hook of the short rope end of the descender into the dorsal lug on the backplate of the casualty's safety harness and secure it
- Move the casualty over the edge of the nacelle wall (K06 and K08) or through the transport hatch, hanging in the safety harness (K07 and K08 gamma)
- Pull the long rope end out of the cam cleat
- Lower the casualty
- The descender brakes automatically
- The long rope end can also be guided manually via the diverter hook on the descender
- During rappelling, ask the casualty to move the legs, if possible, in order to maintain blood circulation.
- On the ground, unhook the casualty from the rope together with a helper and put them in a sitting position,
- After approx. 20 minutes, slowly stretch the casualty's legs and, if possible, place him/her in a horizontal position
- Transfer the casualty to the ambulance for medical care
- Inform the ambulance explicitly about the suspected suspension trauma

GWO BST SEA SURVIVAL

1.5.1 Exposure, Cold Shock, Hypothermia and Drowing

When the human body is suddenly immersed in cold water, the first issues the body needs to cope with are panic and shock. The initial shock places a severe strain on the body, with uncontrolled breathing and a rapid heart rate. After a few minutes the initial response normally eases off and the mental capacity and sufficient strength to act may return. But immersion in cold water quickly numbs the extremities of the body to the point of uselessness. Cold hands cannot fasten the straps of a lifejacket, grasp a rescue line or hold on to a floating object. One can probably swim short distances, but any distance is easily underestimated in cold water. Severe pain may impair any rational thought within a very short time of immersion. And finally, hypothermia sets in and, without rescue and proper first aid, unconsciousness and death follow.

The table below provides an indication of approximate time to unconsciousness and expected survival times based on water temperatures. However, the time a person can survive in cold water depends not only on the water temperature but also on a number of individual factors, some of which can be directly linked to training and situational behaviour of each individual:

- Individual differences: body size, body fat, physical condition, swimming ability, cold tolerance
- External factors: clothing, flotation aides, weather conditions and sea state
- Behavioural response: activity, posture, psychological condition or “will to survive”

WATER TEMPERATURE (°C)	EXHAUSTION OR UNCONSCIOUSNESS IN:	EXPECTED SURVIVAL TIME:
0	< 15 min	45 min
0 - 4	15 – 30 min	30 -90 min
10 - 16	30 – 60 min	1 -3 hours
16 - 21	1 – 2 hours	1- 6 hours
21 - 27	3 – 12 hours	3 hours – indefinite
> 27	indefinite	indefinite

Thermal stability in humans depends on the body's ability to adapt to changes in internal and external temperatures. Heat is transferred throughout tissues and fat, and is released at a rate directly related to the temperature of the environment through radiation, conduction, convection, and evaporation.

Radiation is the transfer of heat through the air from a warmer to cooler area, for example, when patients are left uncovered with large surface areas of skin open to the environment. Radiation typically results from an exposed head and can be responsible for 55% to 65% of a patient's body heat loss.

Conduction occurs through direct contact with cooler objects. It occurs when patients are in contact with metal carts, the ground, or fluids.

Convection refers to the transfer of heat by the movement of air or liquid over skin. Drafts, irrigation fluids, preparation solutions, or baths can contribute to heat loss.

Evaporation is the transfer of heat to the air from moist skin or mucous membranes. It occurs through wet skin, open body cavities, and the respiratory tract.

Hypothermia affects virtually all body systems, as well as the metabolic and coagulative functions of the body. (See the "Physiological effects of hypothermia" box.) As patients become colder, their eventual response is a slower heart rate, decreased myocardial contractility, and impaired use of oxygen by tissue beds. In contrast, traumatic injury triggers an increased heart rate and elevated oxygen delivery to tissues. These diametrically opposed reactions lead to the cataclysmic response that cold has on a patient suffering from traumatic injuries. Among the effects are the following:

- Metabolic. An initial decrease in temperature activates the sympathetic nervous system and triggers the release of epinephrine and norepinephrine, which increase the metabolic rate. This results in vasoconstriction, tachycardia, and increased release of glucose stores to assist in shivering, which facilitates rewarming. As the temperature continues to drop below 86° F (30° C), these hormone levels fall off dramatically, and metabolism slows until tissues beds are left deprived of the oxygen needed to survive. Metabolism switches from aerobic to anaerobic, resulting in lactate as a waste product. This subsequent systemic acidosis results in multiorgan failure.
- Neurological. As the body temperature decreases, mental status changes are the first to occur. The patient may exhibit increased anxiety, faulty judgment, and confusion. As the body temperature drops below 89.6° F (32° C), cerebral perfusion decreases markedly, and there's a subsequent decreased level of consciousness to the point of coma. In severe hypothermia, reflexes slow and eventually cease. Although the patient may appear dead, severely hypothermic patients are sometimes able to recover; therefore, a patient without an obvious cause of death should not be pronounced clinically dead unless his body has been rewarmed to normothermia.2
- Cardiovascular. The initial cardiac response to a mild decrease in core temperature is an increase in heart rate, blood pressure, and cardiac output. This occurs as a result of sympathetic stimulation. As temperatures decrease below 89.6° F (32° C), myocardial activity is suppressed, and the heart becomes irritable to the point of potentially fatal arrhythmias. Additionally, the depolarization of the ventricle slows, which results in a secondary deflection on the QRS complex as seen on an EKG (referred to as an Osborne "J" wave, or hypothermic hump). As the heart becomes suppressed, cardiac output is decreased and less blood is pumped to vital organs, resulting in further systemic insult. Patients with temperatures below 86° F (30° C) are usually resistant to advanced cardiac life support (ACLS).
- Pulmonary. The initial response to mild hypothermia is an increased respiratory rate and depth, but as the temperature continues to drop, the medullary respiratory center becomes depressed and respiratory function decreases. Tidal volume and rate also decrease to the point of apnea in severe hypothermia. In mild to moderate

hypothermia, the mucociliary action and the cough response are suppressed, making the patient more prone to aspiration. An excessive production of tenacious secretions induces a "cold bronchorrhea."

- The oxyhemoglobin-dissociation curve shifts to the left, which means hemoglobin is less likely to release the oxygen molecule, impeding oxygen supplies to the vital tissue beds. A physiologic gap between the alveoli and the capillaries develops, such that areas of the lung become useless in the much-needed gas exchange. This process further contributes to severe acidosis.3,8,11
- Renal. During hypothermia, the severe vasoconstriction that takes place causes a shift of large fluid volume to the heart, which the body interprets as an excess of fluid available and triggers a subsequent diuresis of vital volume. This is referred to as a "cold diuresis."
- Gastrointestinal. In response to hypothermia, liver performance decreases as the patient grows colder, which contributes to bleeding problems. Gastric motility slows and an ileus can ensue, along with severe abdominal distention and an intolerance of any feeding. Furthermore, as gastric motility slows, there's a potential for bacterial translocation into systemic circulation, which can lead to sepsis.10

Coagulation. Alterations in coagulation are a serious complication of hypothermia. It affects both the intrinsic and extrinsic pathways in the clotting process. The true extent of a hypothermia-induced coagulopathy is difficult to evaluate, however, because when partial thromboplastin times (PTT) and prothrombin times (PT) are calculated in laboratories, the temperature of the samples are standardized to 98.6° F (37° C). As a result, the coagulopathy can be significantly underestimated.

1.5.2 Life Saving Appliances and PPE

1.5.2.1 <u>LIFEBOUY</u>

Every lifebuoy shall:

- have an outer diameter of not more than 800 mm and an inner diameter of not less than 400 mm;
- be constructed of inherently buoyant material; it shall not depend upon rushes, cork shavings or granulated cork, any other loose granulated material or any air compartment which depends on inflation for buoyancy;
- be capable of supporting not less than 14.5 kg of iron in fresh water for a period of 24 hours;
- have a mass of not less than 2.5 kg;
- not sustain burning or continue melting after being totally enveloped in a fire for a period of 2 seconds;
- be constructed to withstand a drop into the water from the height at which it is stowed above the waterline in the lightest seagoing condition or 30 m, whichever is the greater, without impairing either its operating capability or that of its attached components;
- if it is intended to operate the quick release arrangement provided for the self-activated smoke signals and self-igniting lights, have a mass sufficient to operate the quick release arrangement;
- be fitted with a grabline not less than 9.5 mm in diameter and not less than 4 times the outside diameter of the body of the buoy in length. The grabline shall be secured at four equidistant points around the circumference of the buoy to form four equal loops.

1.5.2.2 SELF-IGNITING LIGHTS

Self-igniting lights shall:

- be such that they cannot be extinguished by water;
- be of white colour and capable of either burning continuously with a luminous intensity of not
- less than 2 cd in all directions of the upper hemisphere or flashing (discharge flashing) at a rate of not less than 50 flashes and not more than 70 flashes per min with at least the corresponding effective luminous intensity;

- be provided with a source of energy capable of meeting the requirement of previous paragraph for a period of at least 2 hours;

be capable of withstanding the drop test into the water from the height at which it is stowed above the waterline in the lightest seagoing condition or 30 m, whichever is the greater, without impairing either its operating capability or that of its attached components.

1.5.2.3 SELF-ACTIVATING SMOKE SIGNALS

Self-activating smoke signals shall:

- emit smoke of a highly visible color at a uniform rate for a period of at least 15 min when floating in calm water;
- not ignite explosively or emit any flame during the entire smoke emission time of the signal;
- not be swamped in a seaway;
- continue to emit smoke when fully submerged in water for a period of at least 10 s;
- be capable of withstanding the drop test into the water from the height at which it is stowed above the

waterline in the lightest seagoing condition or 30 m, whichever is the greater, without impairing either its operating capability or that of its attached components.

1.5.2.4 LIFE-JACKET

An adult life-jacket shall be so constructed that:

- An adult life-jacket shall be so constructed that:
- shall not sustain burning or continue melting after being totally enveloped in a fire for a period of 2 seconds.

- at least 75% of persons, who are completely unfamiliar with the lifejacket, can correctly don it within a period of one min without assistance, guidance or prior demonstration;
- after demonstration, all persons can correctly don it within a period of one minute without assistance;
- it is clearly capable of being worn in only one way or, as far as is practicable, cannot be donned incorrectly;
- it is comfortable to wear;
- it allows the wearer to jump from a height of at least 4.5 m into the water without injury and
  without dislodging or damaging the lifejacket.
- shall have buoyancy which is not reduced by more than 5% after 24h submersion in fresh water.
- shall be fitted with a whistle firmly secured by a cord

An adult lifejacket shall have sufficient buoyancy and stability in calm fresh water to:

- .1 lift the mouth of an exhausted or unconscious person not less than 120 mm clear of the water with the body inclined
- backwards at an angle of not less than 20° from the vertical position;
- .2 turn the body of an unconscious person in the water from any position to one where the mouth is clear of the water in not
- more than 5 s.

shall allow the person wearing it to swim a short distance and to board a survival craft

1.5.2.5 THE IMMERSION SUIT

The immersion suit shall be constructed with waterproof materials such that:

- it can be unpacked and donned without assistance within 2 min, taking into account any associated clothing*, and a lifejacket
- if the immersion suit is to be worn in conjunction with a lifejacket;
- it will not sustain burning or continue melting after being totally enveloped in a fire for a period of 2 seconds;

- it will cover the whole body with the exception of the face. Hands shall also be covered unless permanently attached gloves
- are provided;
- it is provided with arrangements to minimize or reduce free air in the legs of the suit;
- following a jump from a height of not less than 4.5 m into the water there is no undue ingress of water into the suit.

An immersion suit which also complies with the requirements of life-jackets may be classified as a life-jacket.

An immersion suit which has buoyancy and is designed to be worn without a lifejacket shall be fitted with a light and the whistle complying with the requirements for life-jackets.
If the immersion suit is to be worn in conjunction with a lifejacket, the lifejacket shall be worn over the immersion suit. A person wearing such an immersion suit shall be able to don a lifejacket without assistance.

In that case immersion suit shall permit the person wearing it:

- to climb up and down a vertical ladder at least 5 m in length;
- to perform normal duties associated with abandonment;
- to jump from a height of not less than 4.5 m into the water without damaging or dislodging
- the immersion suit, or being injured;
- to swim a short distance through the water and board a survival craft.

An immersion suit made of material which has no inherent insulation shall be:

- .1 marked with instructions that it must be worn in conjunction with warm clothing;
- .2 so constructed that, when worn in conjunction with warm clothing, and with a lifejacket. If the immersion suit is to be worn with a lifejacket, the immersion suit continues to provide sufficient thermal protection, following one jump by the wearer into the water from a height of 4.5 m, to ensure that when it is worn for a period of 1h in calm circulating water at a temperature of 5°C, the wearer's body core temperature does not fall more than 2°C.

An immersion suit made of material with inherent insulation, when worn either on its own or with a lifejacket, if the immersion suit is to be worn in conjunction with a lifejacket, shall provide the wearer with sufficient thermal insulation, following one jump into the water from a height of 4.5 m, to ensure that the wearer's body core temperature does not fall more than 2°C after a period of 6h immersion in calm circulating water at a temperature of between 0°C and 2°C.

A person in fresh water wearing either an immersion suit or an immersion suit with a lifejacket, shall be able to turn from a face-down to a face-up position in not more than 5 seconds.

1.5.2.6 THE ANTI-EXPOSURE SUIT

The anti-exposure suit shall be constructed with waterproof materials such that it:

- provides inherent buoyancy of at least 70 N;
- is made of material which reduces the risk of heat stress during rescue and evacuation
- operations;
- covers the whole body with the exception of the head and hands and, where the
- Administration so permits, feet; gloves and a hood shall be provided in such a manner
- as to remain available for use with the anti-exposure suits;

- can be unpacked and donned without assistance within 2 min;
- does not sustain burning or continue melting after being totally enveloped in a fire for a
- period of 2 seconds;
- is equipped with a pocket for a portable VHF telephone;
- has a lateral field of vision of at least 120°.

  An anti-exposure suit which also complies with the requirements of life-jackets may be classified as a life-jacket.

An anti-exposure suit shall permit the person wearing it:

- to climb up and down a vertical ladder of at least 5 m in length;
- to jump from a height of not less than 4.5 m into the water with feet first, without
- damaging or dislodging the suit, or being injured;
- to swim through the water at least 25 m and board a survival craft;
- to don a lifejacket without assistance; and
- to perform all duties associated with abandonment, assist others and operate a rescue boat.

An anti-exposure suit shall be fitted with a light complying with the requirements for life jackets. An anti-exposure suit shall:

- if made of material which has no inherent insulation, be marked with instructions that it must be worn in conjunction with warm
- clothing;
- be so constructed, that when worn as marked, the suit continues to provide sufficient thermal protection following one jump
- into the water which totally submerges the wearer and shall ensure that when it is worn in calm circulating water at a temperature of 5°C, the wearer's body core temperature does not fall at a rate of more than 1.5°C per hour, after the first 0.5 hours.

A person in fresh water wearing an anti-exposure suit complying with the requirements of this section shall be able to turn from a face- down to a face-up position in not more than 5 seconds and shall be stable face-up. The suit shall have no tendency to turn the wearer face-down in moderate sea condition.

1.5.2.7 THERMAL PROTECTIVE AID

A thermal protective aid shall be made of waterproof material having a thermal conductance of not more than 7800 W/(m2.K) and shall be so constructed that, when used to enclose a person, it shall reduce both the convective and evaporative heat loss from the wearer's body.

- The thermal protective aid shall:
- cover the whole body of persons of all sizes wearing a lifejacket with the exception of the face.
- Hands shall also be covered unless permanently attached gloves are provided; be capable of being unpacked and easily donned without assistance in a survival craft or rescue boat;
- permit the wearer to remove it in the water in not more than 2 min,
- if it impairs ability to swim.

The thermal protective aid shall function properly throughout an air temperature range -30°C to +20°C.

1.5.3 Safe Transfer

Offshore wind development is presenting a unique access challenge, involving frequent transfer of small work parties between access vessels and wind farm structures; a worker undertaking routine offshore operations, potentially on a daily basis over the life of an offshore wind farm, is likely to undertake many thousands of transfers during their career.

Every transfer exposes the people involved to a number of significant hazards; given the expected frequency of transfers, extremely robust and repeatable systems are required in order to ensure that the overall risk remains at a tolerable level.

Access and egress in this section is taken to consist of:

- The transfer from an access vessel to the first safe platform on a fixed or floating OREI structure or accommodation vessel;
  - Note that risks relating to the vessel passage, up to the point of transfer, and

any further climbing in order to access the structure, are covered in the sections on vessel selection and work at height; or

- The transfer by helicopter between a helipad (which may be onshore or offshore) and:
  - The nacelle of a WTG, by means of winching between the helicopter and a purpose-designed helihoist platform on the nacelle; or
  - A helideck where the helicopter lands on an offshore structure (such as a substation) or an accommodation or support vessel.

Both of the above types of transfer are regulated under the HSWA; additional maritime or aviation regulations will affect the use of vessels and aircraft for these purposes.

Suitable access arrangements are also required in ports and harbours, and for any other transfers between vessels.

1.5.3.1 TRANSFERS TO AND FROM VESSELS

A range of approaches has been adopted for offshore access from vessels, including:

- Direct step-over from workboats to ladders, with the vessel holding position by thrusting against vertical fenders adjacent to the ladder; this is the most common system in use at present;
- Mechanised systems:
  - Devices such as gangways that assist the transfer from the vessel to the ladder, and are largely passive systems;
  - Active motion-compensated platforms or gangways that give a level step-over from the vessel to a platform on the structure, known as “walk to work” systems.

1.5.3.2 VESSEL TO VESSEL TRANSFERS

Where vessels are provided with dedicated facilities such as boat landings to enable transfer, then the hazards are likely to be similar to transferring between vessels and structures, although with increased potential for risks due to relative movement.

Other forms of transfer may also be used, including:

- Personnel carrier, lifted between vessels using a crane; or
- Pilot ladders.

These approaches involve higher levels of risk, so operations should be planned in such a way as to avoid such methods. If circumstances dictate that an enforced change of vessel is necessary, then the proposed transfer should be subject to risk assessment, to determine whether or not the transfer can go ahead without exposing people to unacceptable risks, and identify necessary mitigation. The MCA and IMCA provide detailed guidance on these transfer methods.

Transfers involving vessels may expose people to risks of:

- Falling down onto the vessel, or into the sea, or being suspended by a fall arrest system;
- Crushing or entrapment due to relative movement between the vessel and the ladder;
- Serious injury from any objects that may drop from the offshore structure during transfer operations;
- Stranding – if metocean conditions change, such as weather or sea state deteriorating, or if very low tides prevent access in areas of shallow water; and
- Whole Body Vibration during transfer in rough sea conditions.

Any means of access will have a limit on the conditions under which it can be used safely; if the means of access does not have the necessary capability for the conditions at the location, then this may mean that access is not available for a large part of the year, potentially resulting in:

- Reduced revenue due to lost generating output if OREIs are awaiting repair; or
- Additional costs if staff and vessels are waiting for suitable weather.

As weather-related downtime is inevitable, it is important to ensure that contractual arrangements encourage the provision and operation of safe and capable systems.

The method of access to be used will affect the specification of access vessels, and the design of corresponding interfaces on offshore structures. This represents a large investment; if it were later decided to change the access method; significant costs could be incurred, particularly if offshore structures were to require modification.

1.5.4 Installations, vessels and WTG's

In the event of an emergency occurring at any stage of the OREI lifecycle, the operator of the development is responsible for leading the initial response, including care and evacuation of any casualties; this reflects the fact that the operator will have people and vessels on site, and is therefore able to provide the most immediate response. Alternatively, during the construction phase, the developer and Principal Contractor may agree that the Principal Contractor will lead the emergency response.

This response will normally follow their predetermined procedures detailed within the OREI's Emergency Response Plan (ERP). If the incident is deemed within the capability of the OREI operator and does not have a critical impact on the health of the individual, then the operator will be responsible for the safe conclusion of the incident. If there is any doubt, or if specific assistance may be required, e.g. the transfer of a casualty from a work boat to an ambulance, then assistance should be sought through the MCA's Marine Rescue Co-ordination Centre (MRCC) with responsibility for the sea area where the development is located.

Should the scale or severity of the incident exceed the operator's capability to respond, and in any case where a casualty's life is endangered, then assistance should be obtained from national marine rescue resources, by escalating the incident according to the procedures defined in the Emergency Response Co-operation Plan (ERCoP). The ERCoP is required to be in place prior to commencement of offshore work, so that roles, responsibilities and resources are all clearly defined in advance of an incident occurring. The ERCoP will be a joint agreement between the operator and the relevant MRCC.

A Search And Rescue (SAR) Mission Co-ordinator (SMC) will be allocated by the MRCC for each incident and will lead subsequent stages of the incident response. Should there be any doubt as to the severity of a casualty's injuries, then a doctor's advice will be sought through the MCA's (MRCC) on-call medical advice providers - either Aberdeen Royal Infirmary (ARI) or Queen Alexandra Hospital, Portsmouth (QAH). The SMC will decide on the proposed SAR plan, taking into account all relevant issues and following detailed discussions with the OREI operator. Should a helicopter rescue be contemplated, then the MRCC will request an aviation asset through the UK's National Aeronautical Rescue Co-ordination Centre (ARCC).

The OREI operator is responsible for the initial stabilisation of the casualty, and providing care up to the point where they have been handed over to external medical teams; depending on the situation, this could be at a local hospital, an ambulance on the quayside, or a helicopter / lifeboat medic.

External assistance could on rare occasions take a considerable time to arrive, therefore the level of medical / rescue provision by the operator should be proportional to the hazard exposure and time for external response; the required level of provision at any point in time therefore depends on:

- The operations being undertaken;
- The location; and
- Any other factors (such as metocean conditions) that could affect external response times.

First aid provision should consider:

- The level of training of technicians;
- Availability of others with additional skills within the OREI site;
- Equipment to be provided; and
- The locations where equipment should be stored, such as in the nacelle, tower, or on a vessel.

OREIs are inherently safe locations and abandonment should only be considered as a last resort.

The OREI operator is responsible for completing hazard identification for all aspects of the OREI and ensuring that proportionate barriers and mitigation measures are put in place. Such measures should form the basis for the OREI ERP, which needs to provide procedures to follow in the event of emergency situations such as:

- Injury or illness requiring rescue and evacuation of a casualty from a WTG;

- Marine accident involving vessel(s) that are supporting the OREI, including person overboard;
- Marine emergency involving vessels unrelated to the OREI, but occurring in its vicinity, such as a drifting vessel.

While the primary responsibility rests with the OREI operator, some foreseeable situations may be beyond their capability to respond. Such contingencies will influence the creation of the OREI ERCoP. Emergency response procedures should take into account nearby offshore energy installations and should declare what assistance could be made available to assist nearby SAR incidents, unrelated to the OREI.

The MCA provide a detailed template for ERCoPs on their website, covering both construction and operations phases. The ERCoP includes information about:

- The company that is developing / operating the OREI, including contact and communication arrangements;
- The OREI, including its location, layout, heights and arrangements for shutdown;
    - During the construction phase, regular updates on activities are required;
    - Vessel information is also required, as the OREI's own access vessels are the primary means of rescue and emergency response;
- The MRCC, including communications systems, and arrangements for the appointment of an On-Scene Co-ordinator (OSC) from amongst the OREI staff to support the SMC in managing the incident;
    - The OSC is a key role, so it is important that sufficient personnel on site at any given time have the training and capability to fulfil this role in an emergency situation;
- The responsibilities and primacy of the different parties involved;
- SAR facilities, including surface craft and helicopters;
- Search planning, including the effects of local currents / wind on a drifting casualty;
- Arrangements for medical support;
- Arrangements for support with firefighting or release of trapped personnel;
- Shore reception arrangements, including transfer and subsequent care, to ensure that interfaces with on-shore support are clearly defined in advance;

- Procedures for informing and supporting next of kin;
- Procedure for standing down SAR participation;
- Procedures for notifying authorities of any criminal activities suspected within or around the site;
- Procedures for handling media relations.

Where the involvement of local emergency services such as coastguard, fire, and medical services is envisaged, preparation of the ERCoP provides an opportunity to determine whether or not these services have sufficient capacity or specialist capability to cope with the potential new demands. Early dialogue between developers and local emergency services will develop a clear mutual understanding of capabilities and operational activities.

It is essential that the ERP and supporting systems and arrangements set out clear priorities for the incident response team, to enable them to manage an incident effectively. PEAR(LS) is a commonly accepted response hierarchy used offshore. It sets out the priorities of the incident response team as follows:

- People – saving and safeguarding life;
- Environment – protection and mitigation;
- Asset – protection of plant and property;
- Reputation – protection of company image;
- Liabilities – commercial and contractual commitments; and
- Sustainability – on-going business continuity.

In the event of an emergency, it is essential that all personnel involved are fully familiar with their roles and responsibilities, which may vary depending on the nature of the emergency and their location at the time. For this reason, thorough training in the ERP and ERCoP is required before each phase of the development lifecycle, or when the plans are updated, together with regular exercises to ensure preparedness. Competence is required in a range of areas, including:

- Casualty rescue and evacuation;
- First aid;
- Incident control;
- Emergency co-ordination;

- Media liaison;
- Communication with relatives
- Regulatory liaison; and
- Firefighting.

Emergency information should be displayed at suitable locations within the OREI, so that it is available to personnel when required. During the construction phase, the Principal Contractor (PC) may take the lead responsibility, rather than the OREI operator; any such transfers of responsibility must be managed with absolute clarity, both within the project team and externally, particularly if handover from the PC to the operator is phased to match the development of different geographical areas of a project. Emergency management teams may need to hire in additional resources, such as vessels, at short notice; this will be more easily achieved if suitable arrangements have been made in advance. While emergency services may be stood down once the casualty has been evacuated to a place of safety, the employer still needs to ensure that the casualty receives all necessary support; this includes practical arrangements, recognising that the casualty may now be in a location that is remote from their home – possibly even in a different country, with no keys, money or change of clothing, and even if they are fit to drive, they are unlikely to have access to a vehicle.

1.5.5 Man Over Board

Man Over Board (MOB) is an extremely serious and potentially fatal event that every CRV crew could experience at least once in their career.

It is vital that drills are conducted frequently with regular crew members. It is a legal requirement for the Captain or designated crew member to brief any new crew or passengers on the procedure, and as with other emergency procedures to record training drills in the vessel log / SSM manual.

The immediate response taken by the crew member witnessing a MOB or realising that a crew member is missing:

- Shout

- Throw
- Point.

Shout

Shout "*Man overboard*". This will alert all crew to the emergency situation.

Throw

Deploy a 'Dan buoy', life ring or similar to provide a floating datum. It does not matter if the person is visible at this time or not. The person in the water may see the flotation device/marker and be able to get to it, if not it serves as a reference point for manoeuvring the boat back to the MOB.

CRV crew wear lifejackets at all times while underway, so the primary function of any equipment thrown in a MOB situation is not necessarily additional flotation, but as a reference day or night.

The equipment thrown should be;

- Highly visible (brightly coloured / reflective tape / flag attached)
- Have a light / strobe attached.
- Be able to be deployed quickly.
- Be affected as little as possible by the wind.

The same equipment would be suitable for use as a floating datum in any subsequent search. **Point**

The crewmember who shouted the alert now points continuously with outstretched arm at the MOB (if still visible) or Dan buoy / marker, ensuring that visual contact is maintained. This will also indicate the MOB's location to the Skipper / helm. It is imperative that this crew member does this and nothing else until relieved from this duty by the Skipper.

Secondary Actions

- Initiate turn.
- Press MOB button on GPS.
- Transmit distress call by VHF

- Assess, approach, and brief & delegate crew on appropriate actions for recovery.

Initiate Turn

In large vessels a common practice is for the initial turn to be made towards the side which the MOB fell from, to reduce the chances of the vessels propellers striking the MOB. The size of most CRV's means that the crew member on the helm is unlikely to respond quickly enough for this to be relevant. Given a reaction time of 3 seconds from the person falling overboard to the helm being put over;

- At 6kts the vessel will have travelled 9m
- At 12kts the vessel will have travelled 18m

MOB Button

The MOB function on the CRV's GPS should be activated at the first opportunity; this will provide a back up to the floating datum, and automatically displays bearing and distance to the MOB waypoint.

Distress Call

Sending out a distress call will ensure that assistance will be available if it becomes necessary. It can always be cancelled should the situation be resolved.

The average CRV carries four crew as its normal complement, and in the event of a MOB there will be two crew needed to help in the recovery of the MOB, and one on the helm. While turning around, sighting the Mob, then preparing to approach and recover, sending a Distress Call may be an unwarranted distraction.

If the MOB is lost from sight, a structured search must be initiated. Being unable to locate a fellow crew member will be highly stressful for all aboard. For the search to be successful correct procedures must be followed.

Crew Tasks

Having sighted the MOB and assessed the situation, the Skipper or crew in charge (Skippers are not immune to falling overboard) will allocate positions to the crew and brief them on appropriate recovery actions. (See Module Victim Recovery)

Post Rescue

The following points must be considered after rescuing the MOB:

- Cancel any Distress Call.
- Continue to monitor the patient's condition – ABCs and treat for shock as required.

Complete the necessary Unit and Maritime NZ forms as required for a MOB incident.

1.5.6 SAR and GMDSS

1.5.6.1 SAR ORGANISATION

Search and rescue (SAR) comprises the search for, and provision of aid to, persons who are feared to be, in need of assistance. The two operations search and rescue may take many forms, depending on whether they are both required, on the size or complexity of the operation and on the available staff and facilities. It is necessary that the available resources are so organised and co-ordinated that effective and extensive search and rescue operations can be assured. This requires the establishment of a search and rescue organisation provided with a SAR plan and the means for carrying it into effect.

International Search and Rescue organisations.

Search and rescue is organised on national and international levels. The most important thing in rescue organisations is that people in distress have confidence in them. It is therefore necessary that people have insight in the basic principles of the rescue organisation.. On December 7th 1944 Search and Rescue for people involved in aircraft accidents was already settled on a small scale international basis, by means of the so-called ICAO-doctrine which was taken over by all NATO partners. As from that date it was compulsory for all NATO members to have a national SAR organisation. The ICAO-doctrine was unchanged so it could also stay in use for non-NATO partners. The most remarkable and important date in Search and Rescue organisation is the formation of the United Nations in 1945. Under auspices of UN we find several organisations, such as:

- ILO , International Labour Organisation

- WHO, World Health Organisation
- WMO, World Meteorological Organisation
- IMO, International Maritime Organisation

In the field of SAR, IMO is the most important organisation in UN. As mentioned before 1960 was a remarkable year in SAR. In 1960 all IMO members signed the SOLAS convention. SOLAS stands for Safety of Life At Sea.

In the SOLAS convention all members agreed on the following:

- Each member is responsible for a so-called Search and Rescue Region (SRR).
- International emergency frequencies are laid down.
- All participants are obligated to render assistance in case of an accident.

Nowadays SAR can be translated as:

- SAR units are on voluntary base.
- Specially trained SAR units.

In order to get SAR operations started it was agreed that in case of an accident the country in whose SRR the accident took place is responsible for the co-ordination of SAR actions, irrespective of the nationality of the person or object in distress. If the position of the accident is not exactly known the most probable SRR country is appointed as the co-ordinating country and remains responsible until the exact position of the calamity is known. The cooperation between the IMO International Maritime Organization and ICAO International Civil Aviation Organization is described in the IAMSAR International Aeronautical and Maritime Search and Rescue manual. In the Volume I, II and III. SAR actions can be divided into two main sections:

- On the shore.
- On the spot.

Actions ashore are coordinated by a so-called Rescue Co-ordination Centre. Actions on the spot are coordinated by either an OSC On scene commander or a CSS (stands for Co-ordinator Surface Search). If a situation occurs where a Search and Rescue mission is to be initiated the normal course of events would be to alert the Coastguard who would take overall control of the incident.

If the nature of the emergency requires the assistance of the Coastguard, they will assume total control until the rescue is complete or the search abandoned. Due to their geographical location, the Coastguard will delegate specific tasks to a person close enough to the scene of the emergency to be able to monitor the situation in detail and who can co-ordinate developments as required. In any large-scale emergency the OSC may also designate tasks. If the number of surface vessels is sufficient, a C.S.S. may be appointed to control the surface search and report to the OSC. For the air search a helicopter coordinator can be appointed to liaison with receptor platforms, organise routing of helicopters and refuelling arrangements. In some instances he may also assist with air traffic control.

1.5.6.2 GMDSS

The GMDSS regulations (chapter IV of the International SOLAS Convention), require that every GMDSS equipped ship shall be capable of:

1. transmitting ship-to-shore Distress Alerts by at least *two separate and independent means*, each using a different radio communication service;
2. receiving shore-to-ship Distress Alerts;
3. transmitting and receiving ship-to-ship Distress Alerts;
4. transmitting and receiving search and rescue co-ordinating communications;
5. transmitting and receiving on-scene communications;
6. transmitting and receiving locating signals;
7. receiving maritime safety information;
8. transmitting and receiving general radiocommunications relating to the management and operation of the vessel; and
9. transmitting and receiving bridge-to-bridge communications.

The major difference between the GMDSS and its predecessor systems is that the radio communications equipment to be fitted to a GMDSS ship is determined by the ship's area of operation, rather than by its size

Because the various radio systems used in the GMDSS have different limitations with regards to range and services provided, the new system divides the world's oceans into 4 areas:

- Area A1 lies within range of shore-based VHF coast stations (20 to 30 nautical miles);

- Area A2 lies within range of shore based MF coast stations (excluding A1 areas) (approximately 100 - 150 nautical miles);
- Area A3 lies within the coverage area of Inmarsat communications satellites (excluding A1 and A2 areas - approximately latitude 70 degrees north to latitude 70 degrees south); and
- Area A4 comprises the remaining sea areas outside areas A1, A2 and A3 (the polar regions).

The GMDSS utilises both satellite and terrestrial (ie: conventional) radio systems. Sea Area A1 requires short range radio services - VHF is used to provide voice and automated distress alerting via Digital Selective Calling (DSC). Sea Area A2 requires medium range services - Medium Frequencies (MF - 2 MHz) are used for voice and DSC. Sea Areas A3 and A4 require long range alerting - High Frequencies (HF - 3 to 30 MHz) are used for voice, DSC and Narrow Band Direct Printing (NBDP - aka radio telex). Equipment requirements vary according to the area the ship is trading to or through.

Accordingly, it is quite possible that a small 300 ton cargo vessel may carry the same amount of communications equipment as a 300,000 ton oil tanker, if they are both operating in the same area.As discussed above, equipment fit requirements vary according to the Sea Area(s) a vessel operates in or through. It should be noted that the requirements are cumulative in nature - ie: an A4 vessel is also equipped, by definition, with equipment for A1, A2 and A3 Sea Areas. In areas where A1 Services are provided, coastal vessels are only required to fit VHF equipment, provided of course that they remain within the declared Sea Area - normally within 20 to 30 nautical miles of the coast. Vessels that trade further from land are required to carry MF equipment, in addition to VHF. Ocean going vessels fit VHF, MF, HF and Inmarsat equipment.