1. Introduction

Damage at construction sites caused by adverse weather is a common occurrence.

The form of a construction site changes during the construction process as does their vulnerability to damage. It is not always cost-effective to spend money on temporary structures to protect them from all elements compared to repairing them if something happens. To increase resilience to adverse weather, contractors often have to spend time, effort and money on temporary works and may be tempted to economise on preparations by gambling that adverse weather will not hit the site at the time when it is vulnerable.

There is a cost/benefit judgement to be made between spending money on weather resilience versus the perceived risk of damage. Risk management techniques are used by contractors and designers to determine the level of precautions they should implement. In addition part of the reason for buying certain types of All Risks insurance is to mitigate the financial risk of weather damage.

Insurers have to judge what it is reasonable to expect contractors to do. To make such a judgement requires knowledge of the types of adverse weather to which a construction project can be exposed and the type of damage that can result. This depends on the location, form and nature of the construction site at the time adverse weather strikes. It is important for insurers to know what types of precaution can be taken so that when projects are underwritten or surveyed before or during construction the underwriter can judge if weather damage risk is being adequately managed.

The subject of weather damage to a construction site is covered in many existing publications. The aim of this policy is to bring together, in one place, references relevant to most sites and summarise the subject. Given the amount of different types of weather the following forms of adverse weather conditions have been identified in this policy:

- Snow, ice and extreme cold
- Strong winds
- Torrential rain and flooding
- Lightning
- Hail
- Extreme heat

Each of the forms of adverse weather listed above have then been considered from the following points of view:

- Projects most exposed to this type of weather
- Potential damage
- Other factors caused by the weather conditions
- Precautions to be taken to minimise damage

2. Definitions

Snow
Frozen precipitation in the form of white or translucent ice crystals in complex branched hexagonal form. Snow most often falls from stratiform clouds, but can fall as snow showers from cumuliform ones. It usually appears clustered into snowflakes.

Winter Storm
Any one of several storm systems that develops during the late autumn to early spring and deposits wintry precipitation, such as snow, freezing rain, or ice.

Ice Storm
A severe weather condition characterised by falling freezing precipitation. Such a storm forms a glaze on objects, creating hazardous travel conditions and utility Problems.

Ice
Water that has frozen. If water is present and the temperature drops below the freezing point of that water, the water will turn into ice. Ice has a greater volume than the water from which it is formed and if the water which freezes is constrained from expanding as it freezes it can generate a significant and in some cases damaging bursting force. Some materials that have water as a component can deteriorate or be damaged if the temperature sinks below the freezing point of the water.

Extreme Cold
No specific definition exists for Extreme Cold but the characteristics of an Extreme Cold event are that temperatures are at or below freezing for an extended period of time.

Wind
Air that flows in relation to the earth's surface, generally horizontally. (Damaging Microbursts can occur generated by air sinking vertically in a very localised area). There are four areas of wind that are measured: direction, speed, character (gusts and squalls), and shifts.

Rain
Precipitation in the form of liquid water droplets greater than 0.5 mm. If widely scattered, the drop size may be smaller. The intensity of rain is based on the rate of fall.

- "Very light" (R--) means that the scattered drops do not completely wet a surface.
- "Light" (R-) means it is greater than a trace and up to 2.5 mm an hour.
- "Moderate" (R) means the rate of fall is between 2.5 to 7.6 mm per hour.
- "Heavy" (R+) means over 7.6 mm per hour.

Flooding
High water flow or an overflow of rivers or streams from their natural or artificial banks, inundating adjacent low lying areas'.

Flash floods occur as a result of the rapid accumulation and release of runoff waters as a result of torrential rainfall, cloud bursts, landslides or the failure of flood control to work. They are characterised by a sharp rise followed by relatively rapid recession causing high flow velocities. Discharges quickly reach a maximum and diminish almost as rapidly.

Local floods are generally confined to rather small geographical areas and are normally not of long duration. However in regions of extended rainy seasons (monsoon climates), local floods may last for weeks, resulting in widespread destruction.

River floods are triggered by heavy rainfall or snow melt in upstream areas, or tidal influence from downstream. Ground conditions such as soil, vegetation cover, and land use have a direct impact on local flow capacities. The river levels rise slowly and the period of rise and fall is particularly long, lasting a few weeks or even months, particularly in areas with flat slopes. Failure or bad operation of drainage or flood control works upstream can also sometimes lead to riverine flooding.

Hail
Precipitation in the form of spherical or irregular pellets of ice larger than 5 millimetres (0.2 inches) in diameter. Hail is formed in huge cumulonimbus clouds, commonly known as thunderheads. Hail falls along paths known as hail swathes. These vary from a few square acres to large belts 16 kilometres (10 miles) wide and 160 kilometres (100 miles) long.

Extreme Heat
Temperatures that hover 10 degrees or more above the average high temperature for the region and last for several days are defined as extreme heat. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when a "dome" of high atmospheric pressure traps hazy, damp air near the ground. Excessively dry and hot conditions can provoke dust storms and low visibility.

3. Snow, Ice and Extreme cold

3.1 Types of work most at risk to this type of weather

- Heavy civil projects which include large foundations and contain large volumes of concrete require special care in cold conditions.
- Transmission and distribution lines extend over long distances and are often made up of light tower structures and cables vulnerable to ice storms, freezing rain and ice build-up.

- Buildings, Warehouses often contain large quantities of brickwork and masonry as well as porous materials. Aluminium and glass curtain walls are commonly used in low and high-rise buildings but it may be difficult to provide adequate heat circulation especially during construction to ensure they dry out without damage. Sprinkler systems and other services may need to be filled with water for testing which can freeze if not properly managed.

3.2 Potential Damage

- Large construction sites with extensive outdoor operations can suffer from snow accumulation due to heavy snow falls so that snow and ice removal become critical to restore safe conditions before proceeding and to keep access routes open. Additional weight (overload) on horizontal surfaces. Snow or ice storms (combined with strong wind exposure) can affect mobile crane booms as a result of the build-up of ice or snow.
- Ice storms and freezing rain can produce some of the most destructive effects on light tower structures and cables.
- When building on frozen ground, permafrost and specific geo-cryological (frozen ground) conditions have to be duly considered in the design of foundations. Temperature variations and continuous permafrost layer thickness can cause distorted buildings, sagging roofs or even structural collapse. During the construction building elements not designed for exposure to frost may be accidentally exposed which can lead to heave or tilting due to the expansion of freezing ground
- Rapid thawing of snow and ice can produce downstream flooding. Drainage and sewage systems can be affected by cold weather because of overflow due to snow thaw. These effects are common when systems are in operation and under construction. Frozen ground surfaces and frost penetration into the ground can result in freezing of pipes and clogging of gutters and inlets. Runoff events can be triggered during warmer weather as a result of rapid thawing.
- Excessive snow load can be imposed on structures which are incomplete and unable to withstand them. Damage to or collapse can occur because of snow or frost accumulation (overload of horizontal surfaces and light structures).
- Slowing or stopping the development of concrete/mortar strengths. Brickwork is affected by low temperature in much the same way as concrete (until the mortar has hardened) and is especially susceptible to frost damage. Porous materials are exposed to freezing/thawing cycles. Concreting and masonry suffer from delayed or poor chemical reactions in the cold and concrete strength development is reduced when temperatures fall below normal. Casting concrete (such as for large foundations) at temperatures below normal but still above freezing requires special precautions since temperature affects the rate at which hydration of cement occurs. Low temperatures retard concrete hardening and strength gain or even make it impossible to

reach design strength at all or result in other damage – cracks easily form which are not compliant with project specifications.

- Damage to rubber, membranes and plastic elements (alteration of material properties or increased brittleness causing cracks as a consequence of shocks/lifting operations). Metals can also become brittle under shocks at low temperatures. Minimum service temperature should be considered for metals to be used for equipment, tools and construction materials since brittleness varies significantly depending on metal alloy specifications. The performance of waterproofing membranes and clay layers depends on material properties which can be impaired by low temperatures. Plastic elements like high-density polyethylene (HDPE) pipes commonly used for pipelines or water distribution systems become brittle under shocks at low temperature requiring careful planning of the installation process. Multi-layer structures and embankments can suffer from poor performance of cement-treated base materials. Cracks, non-cohesive layers and alteration in chemical composition in building materials can be created by cold temperatures resulting in application problems, poor quality, low durability or lack of waterproof properties.
- Building damage or collapse due to permafrost settlement
- Flood damage, landslides or subsidence due to thaw
- Fire damage due to lack of water as a consequence of frozen or ice-blockedpipes/reservoirs making fire-fighting facilities temporarily unusable.

3.3 Other factors caused by the weather conditions

- Labour force safety, efficiency, and health issues to deal with increasing discomfort and hazards for personnel including slippery conditions and difficulties in movement, construction site ingress and egress.
- Mechanical construction equipment which may fail resulting in the need for maintenance / winterization.
- Additional hazards in relation to transportation and mobile machinery operations.
- Provision of adequate site lighting (reduced daylight hours).
- The need for storage areas/shelters and protective measures.

3.4 Precautions to take to minimise damage

These can be classified into three main groups:

- Labour force health and safety on construction sites
- Construction plant and equipment winterization
- General provisions for cold weather construction practice

Labour force health and safety on construction sites

Efficiency in cold conditions (not only in an extreme cold but just with temperatures slightly above zero) is reduced as compared with performance under normal conditions. Tactile sensitivity and manual dexterity deteriorate when the temperature falls below 10° C or when wind-chill is particularly strong. The body has to be maintained at a normal temperature and proper insulating materials have to be used in combination with work planning and shift duration to take into account climatic conditions. Below are other ways to prevent worker injury in cold weather events:

- Train workers to recognize cold weather related injury and illness.
- Reduce workers time spent in cold environments.
- Reduce the physical demands on workers.
- Ensure warm welfare facilities to take breaks and warm up, change out of wet clothes.
- Provide appropriate and extra PPE as required.
- Stay hydrated and nourished, drinking hot drinks and high carbohydrate foods.

Construction plant and equipment winterization

Construction works in cold weather expose equipment to extreme conditions which warrant special care. A proper winterization process has to be planned for all outdoor equipment. This can include the use of winter fuels mixed with antifreeze and auxiliary heat or power for both starting and operation. Equipment requires:

- Reasonable protection with comfort and visibility for the operator.
- Capability to start and re-start reliably and warm-up.
- Proper operation in cold weather (hydraulic components such as pumps and power steering can be impaired by frozen fluids or increased fluid viscosity)

General provisions for cold weather construction practice

Protection of construction operations mainly depends on local conditions at the site and the materials which are going to be used. Measure can include:

- Shelters for workers including:
    - Scaffolding enclosures formed by sheet materials fixed to a framework (translucent plastic materials are best but use of PET or other flammable plastic materials can increase fire exposure)
    - Air-supported structures (tents formed of low pressure cushions with air provided by blowers)
    - Windbreaks
- Safe surfaces for the movement of workers and equipment

4. Strong winds

4.1 Types of work most at risk to this type of weather.

The causes of damage associated with strong wind include:

- wind penetrating a building's envelope
- uplift of the roof structures
- flying debris

Based on past loss events, we illustrate some typical projects which are most exposed to wind forces:

- Buildings, temporary structures and warehouses - wind can tear roofs from buildings, rip sidings from exterior walls, and throw debris through windows. Falling trees can crush roofs and walls. Wind can act on building components: horizontal racking forces (forces that occur in walls parallel to the wind direction), vertical uplift forces (as a result of internal pressurisation and external suction), and overturning forces.
- Bridges or raised platforms - wind gusts at a similar frequency to the structures harmonic frequency can cause poorly designed suspended structures to sway. In dozens of loss events in the 18th and the first half of the 19th Century, oscillation by wind was one of the major causes of damage to bridges.
- Unfinished Structures or suspended loads

4.2 Potential Damage

- Uncompleted structures are more vulnerable than completed ones. The strength and lateral stability of an uncompleted structure are, in most cases, much lower than for a completed one.
- Increased risk of debris being blown around the site hitting personnel or causing damage to buildings or vehicles.
- Temporary security fencing acts as a barrier to the wind and can be ripped off standings or bent / damaged from forces acting on it.
- Uplifting of roofs or other high structures from support coming down on other parts of the construction site causing damage to items not affected by the wind
- Uprooting of trees or pylons, and subsequently falling on materials or buildings.
- Low visibility due to dust or other debris being moved through the air.

4.3 Precautions to take to minimise damage

- Detailed planning of construction schedules should avoid hazardous activities in the storm season to minimise exposure time. If the storm season cannot be avoided a strategy has to be carefully established.
- Awareness of site conditions that require advance attention or special materials is important so as to reduce emergency preparation time.
- Unstable works or assembly conditions should be avoided by providing suitable reinforcement, support ropes or girders. If necessary these should be installed at short notice when a storm is approaching.

- Identify vulnerable materials and work in progress and determine how best to protect these from the effects of strong wind.
- Large pieces of light insulation and surface sheeting materials must be protected from wind forces prior to and during installation, for example by keeping such materials rolled up or packed away until they are used.
- Construction site offices, workers' sheds, building material warehouses, construction equipment, etc. must be securely anchored and fastened in position
- All hoardings, temporary structures, plant and other loose objects must be properly secured.
- Workers other than emergency team members should be evacuated from remote sites when a storm is approaching.
- Keep the project free from an accumulation of debris and scrap material that can become windblown hazards. This will reduce the amount of time necessary to complete preparations on the job site in the event of a storm emergency.
- Loose scrap material should be gathered up and disposed of.
- Vehicle doors should be

Scaffolding and/ Cranes or MEWPS

- Secure scaffolding to buildings or solid structures.
- Replace worn, corroded, or other unsafe components and make regular checks.
- Operation of mobile cranes and MEWP's should be suspended. Booms should be laid down if time permits or the load line hooked to the structure at some low point.
- Check the bearing capacity of the ground under MEWPS / cranes in view of the one-sided load during windstorms. If necessary, plant should be secured with a cable-tensioning system.

Motor vehicles parked at the construction site:

- Put vehicles in a garage / or area out of the way when there are storms or severe weather warnings.
- Be aware when opening doors that gusts of wind might pull them out of your hands.
- Wherever possible park so that doors are opened leeward side of the wind direction

5. Torrential rain and flooding

5.1 Types of work most at risk to this type of weather.

Any project site is potentially vulnerable to flash flooding if the terrain is steep, surface runoff rates are high, streams flow in narrow canyons or valleys and severe thunderstorms prevail.

In built environments a project site located in an area where surface run-off is in excess of local drainage capacity is potentially exposed to localised flooding.

Any project site situated on the low-lying areas in the middle or lower reaches of rivers is particularly exposed to riverine floods. In most major river basins, without extensive flood mitigation infrastructure, flood plains are subjected to annual flooding. A floodplain is an area of mostly flat land surrounding a river, stream or creek that experiences flooding when one of these waterways overflows its banks. Floodplains are divided into two main parts:

- The Floodway: the main area affected by an overflow, where the majority of water gathers to create a new, stronger water path
- The Flood Fringe: the outer area that lies beyond the floodway, where less water gathers and it moves much slower.

5.2 Potential Damage

Minor Flooding - is defined to have minimal or no property damage. In remote areas with few specific impacts, floods with a 5-10 year recurrence interval would be assumed to be causing minor flooding on streams in the area.
Typical damage:

- water over banks and onto the project site but water flow is not deep or fast flowing
- minor damage to trenches, foundations, earth and civil works
- inconvenience or nuisance flooding

Moderate Flooding - is defined to have some inundation of a project site near a stream or river. In remote areas with few specific impacts, floods with a 15-40 year recurrence interval would be assumed to be causing moderate flooding on streams in the area.
Typical damage:

- minor or moderate damage across the project site specifically to civil and earthworks.
- various types of infrastructure rendered temporarily useless e.g. generator station flooded
- unpaved roads probably eroded due to current moving over them

Major Flooding is defined to have extensive inundation of the project site. In remote areas with few specific impacts, floods with a 50-100 year recurrence interval would be assumed to be causing major flooding on streams in the area.
Typical damage:

- substantial damage or destruction across the project site
- infrastructure destroyed or rendered useless for an extended period of time
- damage to earth and civil works likely to be severe.
- loss of transportation access, communication and power
- high damage estimates

In urban areas flash floods are more destructive than other types of flooding because of their unpredictable nature and unusually strong currents carrying large concentrations of sediment and debris, giving little or no time for project or site managers to prepare for it and causing major destruction across the project site.

5.3 Precautions to take to minimise damage

- Appropriately locate the storage of construction materials or earthwork stockpiles above design flood levels
- Provision to move and store all office equipment, plans and materials along with construction plant / machinery within safe areas above the design flood level
- Locate fuel storage/ refuelling areas out of the floodplain
- Adopt a phased excavation program to minimise open works exposed
- Consult frequently with local weather agencies/ bureaus of meteorology.
- Exterior operations shut down for event (e.g. no concrete pours or paving)
- Soil treatments (e.g. fertiliser) ceased within 24 hours of event
- Materials and equipment properly stored and covered
- Waste and debris disposed in covered dumpsters or removed from site
- Trenches and excavations protected
- Perimeter controls around disturbed areas

Site work precautions

- Raise up land where materials and plant can be temporarily located in a rain / flood event.
- Construct earthen embankments or dikes cutting out new water canals to by-pass the construction site
- Excavate a site drainage basin where water accumulates in a safe area where it will not interrupt construction.
- Hold additional sump pumps on site to drain out excavations and draw water down a safe path.

Erosion & Sediment precautions

- Ensure adequate capacity in sediment basins and traps to cater for excessive rainfall. A sediment basin is a temporary basin with a controlled release structure, formed by excavating or constructing an earthen embankment across a waterway or low drainage area. Sediment basins may be placed where sediment laden storm water may enter a storm drain or watercourse, and around and/or upslope from storm drain inlet protection measures.
- Temporary erosion controls deployed:
    - Sediment fences are in place and appropriate to runoff conditions
    - Sandbag barriers installed to block and divert flow
    - Gravel bag berms utilised where appropriate to intercept and filter sediment laden storm water run- off from disturbed areas , retaining the sediment and releasing the water.
    - Use straw bale dikes, where permitted, at the base of slopes to capture incidental runoff and sediment
- Identify existing and/or planned storm drain inlets that have the potential to receive sediment-laden surface runoff. Determine if storm drain inlet protection is needed, and which method to use.

- Install filtration booms at site run-off culverts to control flow into riverways or city storm water system to prevent pollution
- Temporary perimeter controls deployed around disturbed areas and stockpiles
- Roads swept; site ingress and egress points stabilised

6. Lightning

6.1 Types of work most at risk to this type of weather.

Lightning is totally random and therefore any construction project is potentially vulnerable to a lightning strike with 70% of all lightning occurring between 35° north and south of the Equator.

Importantly 16 out of 20 accidents involving petroleum products storage tanks are due to lightning strikes according to the journal of hazardous materials.

6.2 Potential Damage

Within certain geographical areas, lightning is one of the most common weather phenomena.

In the UK approximately 30 to 60 people are struck by lightning each year killing on average 3 people, with 2000 people killed worldwide annually.

Damage from Lightning falls into two broad categories:
- Physical damage to buildings under construction
- Electrical and electronic systems within structures

Due to their high energy electromagnetic effects lightning flashes may affect electrical and electronic systems (lightning electromagnetic impulses – LEMP). While the greatest risk is after construction and installation has been completed damage can occur within a building during the course of construction and prior to handover. Damage can occur either by:
- possible conducted and induced surges transmitted to apparatus via connecting wiring or
- the effects of radiated electromagnetic (EM) fields directly into the apparatus itself.

Surges can be generated either:
- externally – lightning flashes striking incoming lines or the ground nearby the lines and transmitted to electrical and electronic systems via the lines themselves or
- internally – coupling due to lightning lashes striking either the building under construction or the surrounding ground.

6.3 Precautions to take to minimise damage

- earthing (conduction and dispersion of the lightning current into the earth)
- magnetic shielding (spatial shielding by grid-like or continuous metallic shields attenuating the magnetic field inside LPZ arising from lightning strikes direct to or nearby the structure and reducing internal surges,
- shielding of internal lines using shielded cables or cable ducts minimising internal surges induced into the installation,
- shielding of external lines incoming to the structure reducing external surges transmitted to the connected electrical and electronic system)
- line routing of internal lines (by minimising induction loops and reducing internal surges);
- surge protective device system (SPD system), limiting both external and internal surges; this system generally consists of a coordinated set of SPDs.
- Training for all personnel on the 30-30 rule. When you see lighting if you are unable to count to 30 before thunder hits, head indoors and wait 30 minutes.
- All generators and power equipment to be switched off to prevent damage via surges.
- Lightning detectors to be held onsite, to warn of strikes in the distance.

7. Hail

7.1 Types of work most at risk to this type of weather

Any construction project with:
- light metal cladding
- glass-roofed structures or skylights
- plant or materials in the open air

To assess the potential for hail damage at a construction site it is necessary to calculate the product of the maximum-recorded hail stone size at the project location along with the normalised annual frequency of hail at the site. In some locations this information may be readily available and in others will require investigation.

7.2 Potential Damage

Hailstorms can potentially cause damage to any exposed components, materials or structures on a construction site, more so when the hailstone diameter exceeds two centimetres. The level of hail damage depends on the size, density, falling velocity and distribution of the hailstones, as well as the climate, the building structure and the stage of construction. Roofs typically are most susceptible to damage but hail can cause damage to skylights, glass structures and any exposed materials and equipment on site.

In general, hailstone damage can be categorised in two main types:

- Aesthetic / cosmetic - damage that has an adverse effect on appearance of the structure e.g. dents and damaged coatings, but does not affect the performance of the roof or building surfaces.
- Functional or structural – damage that results in leaks and cracks and may reduce the expected service life of the impacted surface.

In either of the above hail damage to impacted property could require repair or replacement to ensure functional performance. In addition, deep hail can easily worsen a flash flood situation. Since ice (hail) floats on water it has the potential to clog drains, culverts and grates and may cause water damage to partly completed works or incomplete structures.

7.3 Precautions to take to minimise damage

- Move any exposed plant or machinery under cover
- Shut off all unnecessary temporary electric systems onsite
- Personnel to find cover
- Installation of plastic screens over fragile elements

8. Extreme Heat

8.1 Types of work most at risk to this type of weather

Extreme heat will have the most direct impact on personnel however it will lead to conditions changing on site that could cause more serious issues.

- Heat radiation leading to auto-ignition
- Scrubland / forest areas becoming dry and more likely to catch fire
- Heat Stress

8.2 Potential Damage

- Fire damage due to auto-ignition, accidental fire start, or arson.
- As with cold weather materials will be affected, this could be drying times or structural property changes such as yield strength.
- Fuels - the amount and type of fuel play a key role in determining the strength and extent of a fire:
  - A 1cm depth of fuel on the ground represents 5 tonnes per hectare. This is considered light fuel loading and could carry a mild fire. Thirty (30) tonnes per hectare or a depth of 6cm is considered a heavy fuel loading.
  - Fuels within 15 metres of a project site should be kept to no more than 8 tonnes per hectare. Grassland areas depend on the amount of cured, brown grass present. On a high fire danger day, a fire in sparse, fully cured grass land may have a 2 metre flame height. If the

project is surrounded by grasslands with heavy levels of cured grass, this may produce 7 metre flame heights.

- Heat stress and other illnesses caused by extreme heat

8.3 Precautions to take to minimise damage

- Ensure adequate fire fighting equipment and sufficient extinguishing agents are available and operative at all times and are regularly inspected
- Site personnel are trained in fire response and fire fighting.
- A reliable fire alarm system is installed and a direct communication link to the nearest fire brigade
- Removal or pruning of trees and shrubs: the management of existing vegetation involves selective fuel reduction
- Raking or manual removal of fine fuels: remove fuels such as fallen leaves, twigs and bark on a regular basis.
- Mowing grass: keep grass short, green and well watered.
- Combustible waste material is removed regularly
- Maintain a minimum of 150 ft (45 m) space separation between materials in the open air and any building undergoing construction
- Locate materials on the opposite side of the building under construction to the prevailing wind.
- Separate materials into small blocks with a minimum of 30 ft. (9 m) space separation.
- Do not store materials under awnings or platforms.
- Locate propane, fuel and lubricant tanks at least 30 feet from structures undergoing construction. Alternatively create a 10-foot zone around the tank using low combustible materials such as rock, gravel or mulch.
- Make sure Hot Works Permits are followed and issued for works

Labour force health and safety on construction sites

Workers who are exposed to extreme heat or work in hot environments may be at risk of heat stress. Exposure to extreme heat can result in occupational illnesses and injuries. Heat stress can result in heat stroke, heat exhaustion, heat cramps, or heat rashes. Heat can also increase the risk of injuries in workers as it may result in sweaty palms, fogged-up safety glasses, and dizziness. Burns may also occur as a result of accidental contact with hot surfaces or steam. Below are recommendations for personnel to follow in these conditions:

- Limit time in the heat and/or increase recovery time spent in a cool environment.
- Reduce the metabolic demands of the job.
- Use special tools (i.e tools intended to minimise manual strain).
- Increase the number of workers per task.
- Train supervisors and workers about heat stress.
- Implement a buddy system where workers observe each other for signs of heat intolerance.
- Provide adequate amounts of cool, potable water near the work area and encourage workers to drink frequently.

- Permit rest and water breaks when a worker feels heat discomfort.
- Avoid alcohol and drinks with high caffeine or sugar.