

# Oxfam Good Practice guidelines for Health and Safety

## for work on water, sanitation and shelter projects

### 1.0 Introduction

These guidelines cover health and safety concerns found in the sorts of construction (and operation) work that Oxfam most commonly undertakes in emergency water and sanitation service provision, but are not intended to comprehensively cover all risk situations. ***Health and safety in the workplace is distinct from insecurity due to violence***, which is not dealt with here, in which life and safety can also be threatened. For situations not covered by these guidelines, further information should be sought, firstly in the country where work is being undertaken or elsewhere if required. ***These guidelines should be seen as a supplement to any national/international health and safety policy/guidelines that may exist and these should be followed as national law requires and where disagreement exist between Oxfam guidelines and the national policy, the later should be followed.*** However where relevant national/international policy does not exist, this does not imply that risks are negligible or non-existent, but rather that risk will need to be assessed and a view reached accordingly.

This document is aimed at giving guidance to reduce the likelihood of accidents and illness occurring amongst any “people in the workplace”, e.g. daily labourers, staff directly employed by Oxfam, labour and “volunteers” working for Oxfam’s local partners (NGOs/CBOs), contractors and visitors. Though it should be recognised that Oxfam will not have full responsibility and the same ability to influence partner’s health and safety practices, it would be appropriate to highlight responsibilities and concerns in any MOUs with them and to encourage good practice. ***Note: The use of the words “people in the workplace” throughout this document shall be considered to include employees, contractors and volunteers.***

### 2.0 The degree of risk.

The construction industry, in which these sorts of projects can be categorised, employs many poor and often unskilled people in developing countries and it is one of the most hazardous forms of livelihood. “Wherever reliable records are available, construction is found to be one of the worst, and often the worst industry on health and safety criteria. Limited available records suggest the following;

- The construction industry has almost six times as many fatalities and twice as many injuries per hour worked compared with the manufacturing industry (USA).
- 1.5% of construction workers were killed and 5.3% disabled in one year (USA) ”<sup>1</sup>.

<sup>1</sup>WELL review of safety in construction and operation in the WS&S sector, Pt1, Larcher, Sohail  
This data is based upon industrialised countries, but while the poor or non-existent regulatory framework in developing countries provides little hard data, they do follow a similar pattern and because the types of injury are not high tech, this suggests that the dangers are likely to be similar. In addition legislation is often non-existent in many developing countries, (though ILO

Convention 167, labour provision agreements may cover some aspects) and hazard awareness amongst illiterate/semi literate workers is much less than in industrialised countries. Where accidents do occur they often remain unreported.

In the context of working in disaster response, there are often pressing humanitarian needs that demand urgent action and construction of water/sanitation/shelter services in the shortest possible time frame. This has three obvious consequences, which will conspire to increase the likelihood of accidents and mistakes being made;

1. A tendency for “people in the workplace” to work rapidly which may cause them to work in a way that exposes them to greater risk.
2. Extreme work pressures are more likely to make “people in the workplace” tired and fatigued such that they are more prone to accidents.
3. Implementing work rapidly, often in remote locations, may mean that material and equipment required for safer work practice is not available at the time the work needs to be undertaken.

In some circumstances there may be risks associated with working in areas where munitions, such as mines, are buried and this risk should be specifically investigated, along with the more obvious risks of working in areas where violent conflict is known to be occurring.

So there would appear to be greater risks associated with construction of water/sanitation/shelter facilities in an emergency, which combine with lower health and safety practices and awareness in developing countries. However many accidents are caused by falls or falling objects and given that most Oxfam water/sanitation/shelter construction activities occur within 3m of the ground surface, the accident rate *might* be correspondingly lower. Note that risks associated with contamination (chemicals or cleanliness), confined spaces (bad air), other surprises (buried electric cables hit with pick live cables in damaged areas) and poor quality or overused materials that fail are also likely to be high causes of risk.

Where a disaster poses greater threat to “life and limb” of the populace, *the rigid adherence to health and safety practices in the “work place” that restricts the speed of response could be inappropriate* and thus a view needs to be taken on relative risks. In this regard it is suggested that where a risk assessment of proposed work reveals a low risk for the “people on the site” in comparison to the health risks that the affected population would suffer in the absence of this work being undertaken or being delayed significantly, then work is undertaken. Where the reverse is true, then the work should be delayed until satisfactory arrangements can be made such that undertaking work is of a lower and acceptable risk.

Having said all this, this document is being written not as a reaction to a high accident occurrence on these types of Oxfam projects, but because some aspects of the work environment need to be considered and these have been summarised in this document. Given that the issue of health and safety in the construction place in the context of humanitarian programming, it should be appreciated that this is a fairly new area for an overall strategy for. Therefore perhaps the goal should be to continually review Health and safety with a view towards taking the right steps towards improvement.

### **3.0 General guidance for all works**

The degree of risk should always be assessed for all projects at the planning stage and on an ongoing basis as work proceeds and this should always form the basis of identifying specific risks

in a particular situation. However this level of attention to health and safety in many project areas may be unknown. Thus it is suggested that there should be a formal safety review at commencement of a new project, with achievable steps on how to improve the current position towards a more sustainable goal, then with specific safety reviews every few months to keep edging towards better safety. This is far better than rigid use of the guidelines as a prescriptive document, partly because these do not cover everything, but the points below will be helpful in pointing out many common considerations and risks.

- Creating a culture of safe working practice and getting managers to support this is a very significant contribution. This will in all probability have to challenge a “macho” culture or culture ignorant of risks that will often be resistant to safe practices. Partner organisations, volunteer beneficiaries, sub contractors etc, should all be included in this and encouraged to do so too.
- Having supervisors with an understanding of risks and a brief to ensure that guidance/standards are followed. This should include supervisors undertaking a risk assessment before work starts.
- Good clear briefing and training of the “people in the workplace” about the job and the risks that may be encountered.
- Undertaking work in a measured and controlled way rather than badly organised and hastily implemented jobs.
- Good advance planning that includes making sure that all necessary safety equipment, protective clothing and material is available before the work starts.
- Work should be arranged so that “people in the workplace” are not made to work at a dangerous pace or for overlong hours. For example, rather than having a gang working for 12 hours, using a morning gang of workers for 6 hours, before handing over to an afternoon gang for 6 hours will not only improve safety, but could potentially speed up the work and spread out the potential wage benefits. The practice of undertaking work on a task basis, where by workers are paid to complete a certain task each day, is preferable to piece work, where by workers get paid for what they produce, could also be beneficial.
- Nutrition. Are the “people in the workplace” being properly fed regularly? They can work long hours and this is mentally & physically demanding. Quite simply a well-fed group of “people on the site” have one less pressing need on their mind and are more responsive to training and more productive. A long work schedule should allow regular food breaks and food being available close at hand.
- Maintaining a clean and tidy working environment and where appropriate marking/fencing this off so people not part of the “people in the workplace” don’t stray into potentially dangerous environments.
- Good quality hand tools (and mechanical plant), though more expensive will not only last longer, but enable work to proceed faster and will be less likely to cause injury during their use, which is a problem associated with cheaper hand tools.
- Where there are traffic and vehicles moving in/near the work area, suitable arrangements need to be made to ensure “people in the workplace” are not exposed to risk from these.
- Where vehicular travel to, from and around the workplace is part of the agency responsibility, this should also be scrutinised as this often creates the greatest risks. This means that vehicles should be roadworthy with checks being undertaken on brakes, steering, lights and wheels on a regular basis. Drivers should be tested to ensure they are competent and safe.
- Be cautious about overloading vehicles beyond their recommended safe carrying load limits especially if traveling long distances or traveling over rough ground.
- Provision of a simple first aid kit and safe water for drinking and washing on hand.
- Having medical back up or referral available in case of accident.
- Keeping a log of all accidents that occur as part of normal project monitoring Suggested

accident report log as below;

<b>Date given</b>	<b>Name of worker How accident occurred</b>	<b>Details of injuries Actions taken to minimise risks of reoccurrence</b>	<b>Treatment</b>

- Have an understanding of any national health and safety legislation and practises that may be applicable.
- Use of notices and warning signs, with safety work sheets/plans in languages (images) that all understand.
- Have a good disciplinary system so that those who regularly do not abide to the safety guidelines get warnings and potentially loose their job. This should include getting “people in the workplace” to sign sheets to say that they have been informed of the health and safety guidelines and will abide by them.

### **References/material sources;**

- BDA Code of Safe Drilling Practice 1992
- UK) Control of substance hazardous to health
- (UK) HSE information sheet, construction sheet No 17
- Oxfam guidelines for water treatment in emergencies, Richard Luff
- Oxfam instruction manual for coagulation and disinfection equipment, Richard Luff
- Oxfam instruction manual for hand dug well equipment, Richard Luff
- Oxfam instruction manual for water pumping equipment, Richard Luff
- WELL review of safety in construction and operation in the WS&S sector, Pt1, P. Larcher, M. Sohail
- WELL review of safety in construction and operation in the WS&S sector, Pt2 M. Sohail

## Annex      Checklists for specific types of work

This annex tries to identify some of the major types/categories of work that Oxfam GB is involved with and within these, list some of the specific risks. *Again it is important to stress that these should not be viewed as complete list of all risks that may be encountered, only a risk assessment undertaken by a person with relevant experience can do that.* Therefore these points should only be used as a checklist for *many* of the risks that may be encountered.

It is appropriate to repeat the statement about relative risks from section 1 here. “Where a disaster poses greater threat to “life and limb” of the populace, *the rigid adherence to health and safety practices in the “work place” that restricts the speed of response could be inappropriate* and thus a view needs to be taken on relative risks.”

### 4.1      Water/sanitation works

Oxfam undertakes the bulk of its work in emergency water and sanitation provision and the following considerations should be taken into account.

- Many of the boxes which Oxfam kit come in are heavy, some weighing up to 700kg. Often Oxfam works in situations where mechanical lifting equipment is not available and much human lifting of these boxes is unavoidable. Some kits in the boxes cannot be broken down into smaller components e.g. pumps, and therefore heavy crates will need handling. European regulations now specify a maximum weight of 25kg per person that can be lifted. However regulations used to specify a maximum of 50kg per person to be lifted and this may be a more appropriate weight to use as a guide as to the number of people required to lift boxes. The weights and dimensions of all boxes are included in the Oxfam equipment catalogue. Clear supervision, along with straps and poles will help reduce injury or accidents. Protective gloves and leather boots, rather than sandals will also be important to consider using. These loads should preferably be kept close to the ground during movement.
- Loads of equipment should be correctly positioned and secured firmly on/in the back of lorries.
- Handling of the Oxfam water tank sheets, codes T11S, T45S, T70S and T95S needs particular care because of the sharpness of the edges, which can easily cause cuts and wounds. Gloves worn when unloading/handling these sheets are very useful, but care also needs to be taken when moving these around to avoid other workers coming into contact with these.
- Construction of all Oxfam water tanks, 11 m<sup>3</sup>, 45 m<sup>3</sup>, 70 m<sup>3</sup> and 95 m<sup>3</sup> will require use of ladders and/or scaffold platforms for access in/out during construction. Use of inappropriate materials or techniques such as climbing these for access should be avoided.
- When PE water pipe is supplied in coils, as in code DMP3 and DPP2, these need to be opened with care as there can be a tendency for the pipe to spring out when straps are cut. These should be cut progressively, starting with the strap nearest the end of the pipe on the outside of the coil.
- Trenching requirements for pipe laying will usually involve use of spades, picks and the wearing of shoes/boots is preferred to sandals. However it should be noted that where workers are from rural areas, digging as part of agricultural activity will probably have always been undertaken in traditional footwear using similar or the same tools and this familiarity and habit may mean it is appropriate for workers to continue digging work wearing their traditional footwear.
- Any excavation where there is the risk of collapse should have its consequences considered, e.g. a 300mm deep trench next to a wall could weaken the foundations and cause the wall to

collapse or a 600mm trench could collapse onto someone's legs knocking them down so that their chest is immobilised enough for them to be unable to breath. However particular care must be exercised for excavations deeper than 1.5m, e.g. for latrine pits and deep pipe trenches, and these should take into account soil stability where there is a risk of collapse and the sides stabilised if required. Drainage arrangements to ensure surface water runoff during rainfall should be adequate to prevent water going into pits, as this will cause instability. Where possible latrine pits should be small and circular as this reduces likelihood of collapse during excavation and during latrine use where pits are intended to be unlined.

- Handling of wet mortar/concrete should be undertaken using gloves. Direct contact of mortar/concrete with the eyes especially and skin is to be avoided and where this occurs, facilities should be available for washing the area affected immediately.
- Breaking rocks/bricks by hand should be done with good hammers, gloves and safety goggles.

## **4.2 Handling of chemicals for water treatment and vector control**

Oxfam most commonly uses various chlorine products, as well as aluminium sulphate in its water treatment processes, especially when used for treatment of bulk supplies of surface water and also some chemicals for vector control. Some of these guidelines are taken from the coagulation and disinfection manual, while other points have been added. In UK, COSHH regulations (control of substances hazardous to health) apply and can be consulted for more information.

Some general considerations apply;

- Care should be taken that substances cannot be absorbed through the skin or swallowed and appropriate protective clothing and washing facilities should be made available.
- Employees should be provided with information about the risks entailed in handling the substances they work with.
- Employees should be properly trained when these substances are used.
- Safety performance should be monitored and those employees not complying with good practice should either be retrained or removed from working with these substances.

### **Use and safe handling of chemicals**

The bags or containers of chemicals should be kept in a secure store. They should be protected from rain, damp and sun, and should be stored off the ground on wooden pallets or similar. Poorly stored chemicals can spoil and be of little or no use. Chemicals should be treated with care. Aluminum sulphate and, especially chlorine, should only be used in well-ventilated areas. Avoid breathing in the fumes/powder of the chemicals.

Aluminum sulphate (alum) solution is highly corrosive. It will slowly dissolve metal drums. Suitable arrangements should be made to dispose of aluminium sulphate flocs after water treatment. This waste needs to be disposed of in a manner that does not contaminate water supplies or constitute a health hazard. The easiest method in the short term will be to dig a suitable drainage channel, filled with coarse sand/gravel, where the liquid load can be separated out from the solid flocs, these can be then be dried and disposed of by burial in plastic bags/sheeting.

### **Safety when using chlorine**

All forms of chlorine used as water disinfectants can be dangerous if not stored and handled in the correct manner. Once it becomes wet, or is mixed with water, it becomes caustic. When mixing with water, add small quantities of powder at a time, and stir carefully to avoid splashing.

The following simple rules must always be followed and any particular advice and precaution supplied with a specific product should likewise be closely followed;

- Only trained and authorised personnel should be allowed into the chlorine store.
- Chlorine is caustic, i.e. can cause burning and must not come into contact with skin or clothing. Thus protective clothing such as gloves, goggles and overalls or apron is advisable. (This equipment is available in the Oxfam kit code XSO.)
- Chlorine should be stored under dry, cool dark conditions, preferably raised above ground. Keep all containers closed and covered with a tight fitting lid when not in use.
- Avoid breathing chlorine dust, as it is an irritant to the nose and lungs.

If chlorine solution should splash on your skin or hands, wash it off immediately with plenty of water. If the solution should splash in your eyes, rinse them repeatedly with clean water, and see a doctor as soon as possible.

#### **Vector control chemicals.**

Two main chemicals are likely to be used for dipping mosquito nets, Delthamethrin and Lambda-cyhalothrin, though other chemicals may be encountered too. Where workers are required to undertake spraying activities they should be fully equipped with gloves, goggles, face mask and overalls (as found in Oxfam kit, code XSO). Gloves must be used when dealing with Delthamethrin and Lambda-cyhalothrin, as they are known to cause skin irritation. Overdose of Lambda-cyhalothrin may cause people using treated nets to sneeze. This product can be harmful to fish and should not be allowed to pollute aquatic habitats.

### **4.3 Mechanical Drilling programmes**

Much of this information is drawn from the British drilling association code of practice, which constitutes some of the most stringent rules in the world. Given this then, the points written here need to be viewed with this in mind and it is suggested that a much more flexible view on these.

Oxfam sometimes undertakes well drilling programmes in order to exploit groundwater resources. While contractors may be hired to do the work, Oxfam also runs operational projects and in this case particularly, the responsibility for health and safety lies with Oxfam.

#### **Preparation for drilling**

- A site appraisal should be drawn up to identify any particular hazards, including hazards to vehicular access which pay particular attention to soft/steep ground conditions, as well as drilling work. Though (Oxfam) drilling will often be undertaken in rural areas, in some cases work may occur in urban/peri-urban areas in which case any buried services such as electricity, water, gas etc will need to be located to avoid damage and possible safety risks.
- Movement of drilling equipment to, from and around drilling sites involves movement of bulky and/or heavy equipment. Caution should be taken to ensure that;
  - All vehicles/trailers are in road worthy condition and drivers are familiar with hauling these types of loads in addition to being competent and safe.
  - Driving on and off roads takes into account road and ground conditions and being aware that heavy equipment, often being towed on trailers, is much less manageable and could be prone to loss of control.
  - Vehicles and trailers require careful loading to ensure that loads are well fixed and balanced before driving off.
  - Large vehicles will need special care, especially in manoeuvring and the use of an assistant to help in manoeuvring may be appropriate.
- The drilling work area should be levelled, with drainage installed if required and marked out

with tape/fence and only the workforce allowed inside.

- Where the drilling operation requires use of ladders/scaffold towers, these should conform to all the normal requirements such as length, safe fixing etc.
- Jacking points should be set up carefully, using boards as footings to ensure the ground can take the load. Additionally blocking is important where employees have to work under the machine.
- Operation of engines on compressors, mud pumps, foam pumps etc all require the normal adherence to safety practices (see above section 3.2 for further information).
- Moving engine and drill parts should be protected with guards where possible.
- High-pressure circulating fluid lines need to be adequately protected from damage through use of boards, sleeved in water pipe etc.
- Bulk stocks of fuel, oil (and gas cylinders) should be stored in a designated place remote from the immediate working area.
- Racking of drill pipe should be adequate to carry the weight of the pipe and to allow safe handling.
- Where drilling will be undertaken at night adequate lighting should be available and be used.
- All personnel within this area should wear safety helmets, have the use of short tight fitting gloves and wear stout boots and close fitting overalls. Long hair, scarves and loose fitting clothing will need to be tied back or removed. Eye protection should also be worn during cutting, grinding, scrapping etc or when using dangerous chemicals (along with rubber gloves, apron etc for chemical use).
- In order to minimise the risk of water contamination the drilling team should not be carriers any water borne disease and checks should be undertaken on their health status.

### **During drilling**

- Each person on the drilling team should have a clearly designated job and perform according to this requirement unless specifically asked to do so by the supervisor.
- The drilling team should be issued with all safety clothing such as overalls, boots, helmets, ear protectors and gloves.
- Daily checks should be made on the condition of the drilling rig and any potentially unsafe conditions should be noted in the drilling logbook. Hydraulic hoses and fittings that are damaged should be replaced immediately.
- Excessive speed is destructive to both machinery and equipment and is a major factor in accidents, so all drilling should proceed methodically and not too rapidly.
- When handtools such as pipe tongs, wrenches etc are braced against the drill frame and used against the drill rotary power as break out tools, such tools should be secured to the drill frame.
- Care should be taken when using wrenches, hands should never be placed on wrenches when they can get trapped between wrench and rig, and wrenches should not be used on moving drill rods.
- The drill pipe should be handled using gloves and the working platform should be free of grease, mud or ice. Drill rods should not be handled at the male end and care should be taken to file down burrs before joining pipes.
- Drill rods should be stored careful and never leaned against the drilling mast.
- The hoisting plug should always be fully screwed into the rods and tightened by means of wrenches before commencing to hoist or lower the plug
- Workers should engage in hygienic work practices and boots/clothing etc should be disinfected using a 1% chlorine solution.
- Suitable arrangements to ensure that water supply from the well is not going to be a health risk during water supply after the well has been completed. This means ensuring that water is



pumped to waste away from water sources and that the well is disinfected by a strong dose of chlorine.

### **Compressors**

- Compressors should be set up on level ground, with brakes/blocks used to secure them and sited so that exhaust fumes do not enter the borehole.
- Compressors should be fitted with air pressure gauges and these used to monitor that equipment is functioning properly.
- Hoses and fittings designed for different working pressures should be marked and not be used for pressures higher than designated.
- When hoses are used for pressures in excess of 18 bar, these should be secured to restraining anchors at each end and at suitable intervals,
- Compressed air should not be used for odd jobs such as removing liquid from storage drums unless the airline is fitted with the correct end fittings.
- Compressed air supply should never be cut off by kinking or bending of hoses.
- Compressed air should not be used to blow dust from wearing apparel whilst being worn, as this can cause serious injury or death.

### **Other points**

- All machinery should be regularly inspected, lubricated and serviced. Cleaning of equipment should occur regularly and parts relubricated when water is used for hosing down.
- Drilling site must be kept in a tidy and clean condition such that each new work shift can start their work in an ordered and safe way.
- When wells are abandoned they should be suitably capped off. Where wells are to be fitted with pumps at a later date they should be temporarily capped.
- All staff must be thoroughly trained in and conversant with the equipment use and risks associated with drilling. This should place emphasis on each crew member being trained to do their own job safely as well as efficiently. This training should be formally undertaken and logged, with details of the training given, by who and to whom.

## **4.4 Shelter/house repair and building**

Oxfam is involved with shelter provision in a variety of contexts, from relief interventions to rehabilitation and provision of new housing stock. Relief interventions are invariably distribution of materials such as plastic sheeting, CI sheets, bamboo/timber poles and work is commonly undertaken by the affected population, sometimes on a voluntary basis, at other times with financial or food incentives. Most of these materials are those that people have built with traditionally, so familiarity with handling these is high and construction of small single story dwellings in this way will entail little risk.

However construction of new houses that may be upgraded permanent housing for affected populations is likely to entail more risk. Also in situations such as the Balkans, Caucasus etc, displaced populations may be living in existing public and private buildings, sometimes multi storey that need modifications/refurbishment in order to make these habitable and risks will be greater in these situations. ***Note this section is NOT comprehensive with regards to this type of work and where it is being undertaken, detailed health and safety documents MUST be consulted for further advice.***

The following list highlights some of the major concerns;

- Where electricity is being installed/repared the normal range of electrical hazards exist.

Cables and leads should be protected from damage by sheathing or by positioning away from potential damage. Work on electric cables must not proceed until these have been electrically isolated and checked that these are not live.

- Some work on rehabilitation of existing buildings, which may be more than one storey high, could involve work on first floor level and above. In these cases particular care needs to be taken to ensure that there is scaffold access where required, ensuring that this is properly erected, secured to something immovable, has proper platforms with toe boards, is strong enough to take weight of material placed on it and is inspected regularly. Where ladders are used, these should rise a sufficient height above their landing place, resting on solid surfaces and secured. Openings in floors/roofs, doorways, windows need to be marked/fenced off to prevent accidental falls occurring. Work personnel should either be wearing helmets where there is a risk that materials/tools can fall on them, or areas below work occurring higher up fenced off.
- Handling and placement of glass panels for doors and windows should be undertaken using gloves.
- Wheelbarrows, material hoists etc should be used to minimise manual lifting.

## **4.5 Miscellaneous**

Natural disasters, particularly earthquakes, but also floods and other events can create potential hazards. In the aftermath of an earthquake for example, the instability of buildings poses a particular risk and expert advice should be sought before entering affected areas.

## **4.6 Use of Oxfam centrifugal suction pumps**

The following points are extracted from the Oxfam pumping manual, covering 2”/4” centrifugal suction pumps. Many of these of these points are applicable to locally purchased pumps of the same type and for diesel/petrol engines generally, while a few are applicable to pumps in general.

- Ensure the engine is securely mounted.
- Ensure that there is an adequate supply of cooling and combustion air available to the engine.
- Never operate a diesel engine or standard electric motor powered unit in an explosive atmosphere, near combustible materials or where insufficient ventilation exists.
- Ensure the engine and surrounding area is kept clean.
- Ensure all safety guards are in position.
- Keep clear of all moving or hot parts and secure any items of loose clothing.
- Never allow any unprotected part of the body to come into contact with high-pressure fuel oil: for example when testing fuel injection equipment.
- Thoroughly clean any lubricating or fuel oil from the skin as soon as practicable after contact.
- Rectify all fuel and oil leaks as soon as practicable.
- Clean fuel and oil spillage as soon as they occur.
- Some of the materials used in the manufacture of filters and elements could give off toxic gases if they are burnt.
- The materials used in the manufacture and treatment of some filters may cause irritation or discomfort if they come into contact with the eyes or mouth.
- Used liquid filters and elements contain some of the filtered liquid and should be handled and disposed of with care.
- After handling new or used elements the users hands should be thoroughly washed,

particularly before eating.

- Some engines may be fitted with seals of 'O' rings manufactured from VITON or a similar material. When exposed to abnormally high temperatures, in excess of 400°C (752°F), an extremely corrosive acid is produced which cannot be removed from the skin. If signs of decomposition are evident, or if in doubt, always wear disposable heavy-duty gloves.
- These pumps should only be used to pump clean or slightly polluted water and some mild chemicals between temperatures of 4°C and 80°C. Do not pump flammable liquids such as petroleum-based products.
- Observe all safety precautions for the handling of fuel and never refuel an engine whilst it is still running. This should include use of gloves when there is chance of direct contact with diesel.
- The pump body must not be subjected to more than the rated internal pressure (14 bar for P4H, 10 bar for P4H, 5 bar for PR2). The pumps themselves cannot develop more pressure when operating at their normal speed maximum speed of 2,590 rpm (3,600 rpm for PR2), therefore:
  - Ensure that there is no high positive suction pressure (such as flooded situation) which would increase the total system pressure over the maximum limit.
  - Do not exceed the maximum speed.
  - Ensure that there are no quick-closing valves in the system which could generate hydraulic shock
  - Ensure that there are no sudden obstructions of the discharge line, such as a vehicle driving over the hose
- Do not run the pump dry and always ensure that the pump body is filled with water before starting up the pump.
- The lifting plates fitted to the engine are designed for lifting the engine and the fitted accessories. They must not be used to lift complete pump assemblies.

## **4.7 Hand dug well construction**

This safety section is taken from the Oxfam manual "Hand dug wells" and outlines essential precautions to be observed during construction and commissioning of the well.

### **Dangers and safety measures for hand dug wells and similar engineering projects**

Digging holes in the ground whether for wells, quarrying, foundations or any other purpose, is a potentially dangerous operation. In geographical areas, where well digging is a local skill, the dangers arise from familiarity; while in other areas it is the lack of knowledge, which presents serious risks.

It is of paramount importance that all reasonable precautions are taken to ensure that what is intended to be a life saving project (the provision of good water supplies), does not cause tragic loss of life or limb through ignorance or carelessness during the construction or maintenance operations.

The danger areas shown in figure 34, should be noted and continually brought to the attention of workers and to the local population, during the construction of a well. Equally important, especially for a community that has not previously had the use of a well, are the safety precautions to be observed during the life of the well and particularly during maintenance, cleaning or deepening operations.

### **Before starting well construction**

The people/supervisor responsible for the well digging operations should answer the following questions:

- Is your equipment adequate and well maintained?
- Is your team experienced in well digging? Are they aware of the dangers and risks?
- Have they all been provided with safety helmets, and are they willing to wear them?
- Are they trained in First Aid, resuscitation techniques, and use of safety lamps?
- Have you agreed the signalling system and made sure everyone is familiar with it?
- Is your dewatering pump safe? If you expect to dewater below 7 metres from ground level, make sure you have an air driven pump (or electric submersible with safety features).
- Never lower an internal combustion engine into a well.
- Do you have sufficient, appropriate materials to support the sides of the excavation?
- Is all your safety equipment ready for use? (See equipment list).
- Is the community aware of the dangers existing around the well and equipment, i.e. children and animals falling down the well, etc?
- Have you fenced off the working area?

### **During well construction**

- Don't take risks!
- Clear the area for at least 2 metres all around the well and keep it clear of people, animals, materials, equipment (especially fuel/oil containers).
- Provide a kerb all round the well made of timber or rock if possible, to prevent stones, tools etc. being kicked into the well.
- Do not construct a well less than 750mm in diameter if people have to enter the hole, (i.e. excluding boreholes drilled/augured from the surface).
- Watch for soil cracks at the surface and in the walls of the excavation, also for incoming water or loosening soil. Support the sides of the hole as necessary so that the walls do not collapse on top of the diggers.
- Keep a reliable person at the top of the well at all times when people are in the well. Only one/two trained, reliable people should be in charge of the winch operation. Keep noise levels down so that what is going on in the well can be heard.
- Keep the well ventilated.
- Make sure everyone in the well can be seen from the surface, and can get out quickly. Lower and raise workers with a safe seat.
- Tools should be lowered into the well, not carried by hand, or they might drop on someone's head.
- Do not lower well rings or other heavy items with anyone below. Get people out first!
- Never look down the hole, or climb down, without your helmet chin strap fastened!
- Arrange some shade for diggers to rest in when they return to the surface.

### **Within the well**

- Secure ladders.
- No smoking.
- No matches.
- No naked lights (except for testing the air).
- No nylon ropes (static electricity causes sparks which can cause explosions if there is methane about).
- Never load a bucket/kibble above its rim and loose material.
- Always provide a latrine bucket for lowering into the well when called for as soon as the well is too deep for workers to exist to urinate. Make sure it is regularly emptied away from the

excavation.

- When you hit rock will you need explosives? Make sure you get expert help. Explosives must be stored in an approved magazine (special store room for explosives) and used with great care. Don't take risks!
- Never use an internal combustion engine down the well when you hit water and need to pump it out to continue digging, or to test the well's capacity. Many people have lost their lives breathing engine fumes in wells.

### **After well construction**

General care of the well should involve the community as a whole, while the well maintenance should be the responsibility of chosen people. Women must play a key role since they are the main water collectors and users. Well-maintenance training should outline the importance of:

- Keeping well fencing in good condition so that animals have no access.
- Keeping well parapet and cover (if provided) in sound condition.
- Keeping rope, windlass (if fitted), and buckets in good condition - to be replaced when necessary.

Also, before entry into the well, whether for maintenance, cleaning, deepening or simply to retrieve fallen objects:

- Test air with lighted candle, lowered to the bottom.  
Do not enter if candle is extinguished.  
Clear air by lowering and raising a brush of twigs/branches almost the same diameter as the well.  
Retest with candle.
- Make sure ladders are in sound condition and are securely fastened.
- Ensure people entering wells are wearing safety helmets and have rope firmly attached to them, with enough people at the surface to haul them to safety if problems arise.
- Agree a signalling system for raising/lowering equipment and personnel.
- If pumping is necessary to lower the water level for cleaning or deepening, make sure that no internal combustion engine is lowered into the well, and that any exhaust fumes from such engines on the surface are directed well away from the well opening.

### **Summary of Dangers and Safety in Hand Dug Well and Similar Engineering Projects**

The Well Safety Display Notice is available from the Public Health Engineering Team, as A4/A3 size and laminated, in English, Spanish, French, Portuguese and Arabic. It should preferably be translated into the local language and prominently displayed.

#### **DANGERS**

1. Lack of knowledgeable supervision.
2. Careless workers and work methods.
3. Interference by onlookers or animals.
4. Faulty equipment: ladders, ropes, supporters, tripods, hooks, buckets.
5. Falling materials.
6. Risk of collapsing soil.
7. Poisonous gases from explosives, petrol/diesel engines, soil methane.
8. Problems of incoming water.
9. Problems of excessive dust.
10. Pollution of well by human excreta, fuels or lubricating oils.

## ESSENTIAL SAFETY MEASURES

11. All hand dug wells and such works must be planned and supervised by competent staff.
12. There must be agreed signalling arrangements and adequate supervision, control and attendance at the well head at all times when digging is taking place. No persons should dig alone. Safe and easy access to the well should be provided.
13. Safe and appropriate well construction techniques must be used, particularly temporary soil support or permanent well lining during excavation. The hole should be protected when digging is in progress or made safe when workers are not on site to prevent people, animals or materials falling in.
14. Good and regularly checked equipment should be used (ropes, ladders, lifting gear, tripods, skips etc). Good quality tools and tool handles for pick-axes, sledge hammers, etc should be provided.
15. Essential safety equipment should be used including safety helmets, harnesses for lifting out injured personnel, gas detection equipment, etc. Goggles and dust masks should be worn for stone cutting, ear protectors if using air hammers. First aid training and equipment should be part of the overall safety measures.
16. Dewatering: Safe and suitable dewatering equipment and techniques must be available and used. The Oxfam system of using a compressed air powered pump or electric dewatering/desludging pump fitted with a special set of devices are the safest techniques available. Under no circumstances should combustion engines, petrol or diesel powered pumps be lowered into wells to facilitate dewatering. This will lead to a lethal build-up of carbon monoxide which will cause death within seconds of anyone present in the well. If diesel or petrol engines are used at ground level, the exhaust gases from such engines must be diverted away from the well or excavation. Exhaust gases are heavier than air and will sink to the lowest levels possible.
17. Ventilation: Keep the well ventilated and test frequently for gases and foul air before entry each day and whenever a new stratum is encountered. The compressor supplying the dewatering pump can also be used to supply air when pumping is not required. If no blower or bellows are available, lower and raise a bundle of brushwood almost as big as the well opening to induce air changes.
18. Use of Explosives: the use of explosives for well blasting must only be carried out by fully competent and trained staff since the storage, handling, placing and detonation of explosives is a skilled operation. It is crucial, following the use of explosives, to purge the well of all toxic fumes remaining after detonations. Air safety tests should always be carried out. Air purging by standard air compressors is not suitable unless the atomised oil content of the compressed air is removed by suitable oil filters (as provided in kit WPC). Locally made explosives using fertilisers, diesel oil, home made gunpowder or similar improvisation should not be used because of their haphazard and erratic performance.
19. Sanitation: facilities or arrangements should be provided to eliminate any risk of well diggers excreting or urinating in the well.