

GUIDE FOR SAFETY WITH

UNDERGROUND SERVICES

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Introduction

- 1 Many accidents occur when underground services are damaged during excavation and other work involving ground penetration. Not all accidents occur immediately; some happen years after work has been carried out, perhaps when a service is damaged and it corrodes over a long period of time. In addition to the risk of personal injury, damage can be very costly and can have knock-on effects. Consider, for example, the effect on a hospital or a home kidney-dialysis patient if services are lost.
- 2 This guide outlines the dangers which can arise from work near underground services and gives advice on how to reduce the risk. It deals only with risks to health and safety and is not concerned with damage which has no attendant risk. However, the precautions needed to reduce the risk of accidents will generally reduce the risk of damage.

Application

- 3** This guide applies to all situations where underground services may be found and where work is undertaken which involves penetrating the ground at or below surface level.

Who Should Use This Guide

- 4 This guide should be used by all those who have responsibilities under relevant legislation (see Appendix 5), including employers, employees, owners of underground services and those concerned with planning, organising and supervising work near such services. This includes work by or for the utilities and also roadworks, construction and demolition work. The guidance is aimed primarily at central and site management (including travelling supervisors) but it also contains a suggested text for information which could be used by employees (see Appendix 7).

How To Use This Guide

- 5 This guide is divided into a main text and seven appendices. Many of the precautions to prevent damage apply equally to all types of buried service, and the main text sets out a general system of work. More specific precautions on each of the four types of buried services are given in Appendices 1 to 4, which need to be read in conjunction with the main text. The other appendices deal with legislation, first aid and a suggested text for employee information.
- 6 The guide was considered by a joint OSH/industry working party which drew on a wide range of expertise. The working party concluded that, in many cases, there are no suitable alternatives to the precautions advocated in the guide. People involved in this type of work who wish to carry it out in some other way than that advocated should ensure they achieve an equal or greater standard of safety.

Definitions

- 7 The term ‘service(s)’ means all underground electricity, gas, water (including piped sewage), telecommunications plant, and liquid petroleum services and oil pipelines. It does not include underground structures such as brick sewers, railway tunnels, etc.
- 8 The term ‘service connection’ means a pipe and/or cable linking a service main with individual premises.

The Dangers

- 9 The main dangers which may arise from work near underground services are summarised below:

Electricity Cables

Injuries resulting from damage to live electricity cables are usually caused by the explosive effects of arcing current, and by any associated fire or flames which may follow when the sheath of a cable and the conductor insulation are penetrated by a sharp object such as the point of a tool, or when a cable is crushed or bent severely enough to cause internal contact between the conductors or between the sheathing and one or more of the conductors. This typically causes severe and potentially fatal burns to the hands, face and body. Direct electric shock is rare but not impossible. (See also Appendix 6.)

Gas Pipes

Damage to gas pipes can cause escapes which may lead to fires or explosions.

There are two types:

- (a) Damage which causes an immediate escape;
- (b) Damage which causes an escape some time later. The damage may

occur at the time the work is carried out (for example damage to a pipe wrapping may eventually lead to corrosion) or subsequently, for instance poor reinstatement may leave a pipe inadequately supported or subjected to unequal forces.

In the former case, the risk is to both the people carrying out the work and to others in the vicinity; in the latter, the risk is mainly to the public.

Liquid Petroleum Services Or Oil Pipelines

Damage to these services is similar to that for gas pipelines.

Water Pipes And Sewers

Damage to water pipes is less likely to cause injury, but a jet of water from a high-pressure main could injure a person or damage adjacent services. In addition, a leak or water from an underground pipe could wash away subsoil and reduce the support for adjacent services, highways and structures.

Further dangers include the risks of flooding the trench or low-lying areas such as nearby basements. Sewers are generally gravity-fed; however, some sewage is pumped at pressure. The main danger from damage to a sewer is the possibility of contamination.

Telecommunication Cables

Although in most situations there is no 'direct' risk of personal injury, there is always the potential for 'indirect' danger if emergency services cannot be called. There is an increasing amount of computer data now transmitted through telecommunication cables. Loss of data results in loss of revenue. It is only a matter of time before someone sues.

Safe Systems Of Work

- 10 Buried services are widespread and it should be assumed that they are present until it is proved otherwise. This part of the Guide aims to help minimise the possibility of damaging them. It sets out a safe system of work which is based on obtaining, before work begins, as much information as possible about buried services in the area and then using that information to ensure safe digging.
- 11 The safe system of work has three basic elements:

Plans

Plans or other suitable information about all buried services in the area should be obtained before excavation work starts, and the owner should do everything reasonably practicable to ensure that such information is made available to enquirers. When this is not possible, as may be the case when emergency or other unforeseen work* has to be undertaken,

* 'Unforeseen work' is work that occurs at such short notice that it cannot be planned in advance. The term does not cover emergencies in which people are at risk, but does include situations where it is considered necessary to start or continue work despite problems that would normally require further information from service owners etc. However, there may be many situations where it would be prudent to delay unforeseen work in order to obtain more information. In particular, a client may plan a job well in advance but only pass it to the contractor at the last minute. Clients should either pass on buried service information to the contractor in good time or allow the contractor time to obtain it from the service owners.

the excavation should be carried out as though there are buried services in the vicinity. Account should be taken of any indications that buried services exist, such as the presence of street lights, illuminated traffic signs, valve pit covers, etc. However, the absence of such indications does not necessarily mean that there are no buried services. (See also paragraphs 16 to 20.)

Cable And Pipe Locating Devices

Suitable cable and pipe locating devices should be used, in conjunction with any available plans, to determine as accurately as possible the position of traceable underground services in or near the proposed work area. These devices will not detect plastic pipes. (See also paragraphs 21 to 24.)

Safe Digging Practices

Excavation work should be carried out carefully, and follow recognised safe digging practices. (See also paragraphs 25 to 34.)

- 12 These key elements — plans, locators and safe digging — complement each other, and all three should be used when working near buried services. Using only one may not be enough: for example, a cable may be shown on a plan as a straight line, with measurements taken from fixed objects at the time of

installation, whereas in practice the cable may snake or may have been moved out of position. Reliance on the plan alone would give a false position, but this could be alleviated by the correct use of a cable locator. If several cables are close together a locator may show them as a single cable, whereas the plan would help give a more accurate picture.

- 13** Anyone responsible for excavation work where buried services may be present should liaise with the service owners (normally the utilities but sometimes other statutory bodies or private companies) when planning and carrying out the work. It is important that owners accept the need for close co-operation with those who have to excavate in the vicinity of their plant. They should be prepared to help locate and identify the plant when asked to do so, perhaps by sending a representative to the site. They should also consider further ways of improving and extending co-operation, particularly with other utilities, local authorities and contractors who have to perform a considerable amount of highway excavation.
- 14** The organisation and arrangements necessary for avoiding danger should be written into, or form part of, employers' statutory safety policies and emergency procedures.
- 15** Employees should receive adequate instruction and training in the above

procedures (see Appendix 7) as a basis for training programmes. It is particularly important that anyone who uses a locator should have received thorough training in the use and limitations of that particular type or model.

Plans

- 16** The owners of underground services must be approached for information and plans well before excavation is due to start. Where consultants and clients (which in some circumstances will include utilities and local authorities) obtain the information they must pass it on to the main contractor, who must in turn pass it on to those involved in excavation and groundwork. It may be possible to amend some projects at the planning stage to avoid existing buried services routes or areas of particular service congestion. For major projects, early approach to services owners is recommended as it may be possible to divert some services from the excavation area.
- 17** Most buried services belong to one of the utilities. Others may be found on or near commercial, industrial, military or other sites, and where known the owners should be consulted. Electrical cables under the highway may not necessarily be owned by the local electrical supply authority (see paragraph 1 of Appendix 1).
- 18** Owners should provide either plans, which show the recorded line and depth (where known) of all their known plant buried in the proposed work area, or other suitable information which assists in protecting the safety of persons. They are

likely to receive many routine applications for information and should consider how best to make information available at short notice. Where reasonably practicable, arrangements should also be made to deal with emergencies outside office hours so that working parties can be given plans of underground services positions when they receive their work instructions. Where reasonably practicable, arrangements should be made to deal with emergencies outside normal office hours.

Some owners may have reservations, for reasons of security, about supplying copies of their underground services plans for such areas as those around important civil and military establishments. In such cases an alternative method should be used; for example a representative could be sent to the site to give information to legitimate contractors/utilities etc.

- 19** Plans are not normally drawn to scale but even if they claim to be, they should not be relied upon to obtain distances; the draughtperson may have made a mistake or reproduction may have changed the scale, especially if the plan was obtained from a microfiche slide or digital map. However, plans can give a good indication of the location, configuration and number of underground services at a particular site, and will help subsequent tracing by locators. Those in charge of site work, and operators of locators, should be aware that plans may show spare ducts, and that the

accuracy of plans is limited because:

- (a) The position of reference points (e.g. the kerb line) may have changed since the plans were drawn.
- (b) Regrading of the surface may mean that the depths shown are now incorrect.
- (c) Services, particularly cables, may have been moved without the authority or knowledge of their owners.
- (d) In many cases service connections are not marked; and
- (e) Services, marked as straight lines may, in practice, 'snake'. Excessively long cables may have been laid in horizontal loops outside substations, switchrooms, etc.

Further notes on the use and limitations of plans for electricity cables and gas pipes are given in Appendices 1 and 2, and examples are shown in Figures 1 and 2. In certain cases, such as construction site work and large-scale excavation work on the highway, it would be useful to transfer the information from the original plans onto the working plans for the guidance of those carrying out the work. Particular care should be taken where topographical changes have occurred since services were laid. Adequate instruction and training in how to read and interpret the plans must be given to anyone who needs to use them.

D A D W A Y

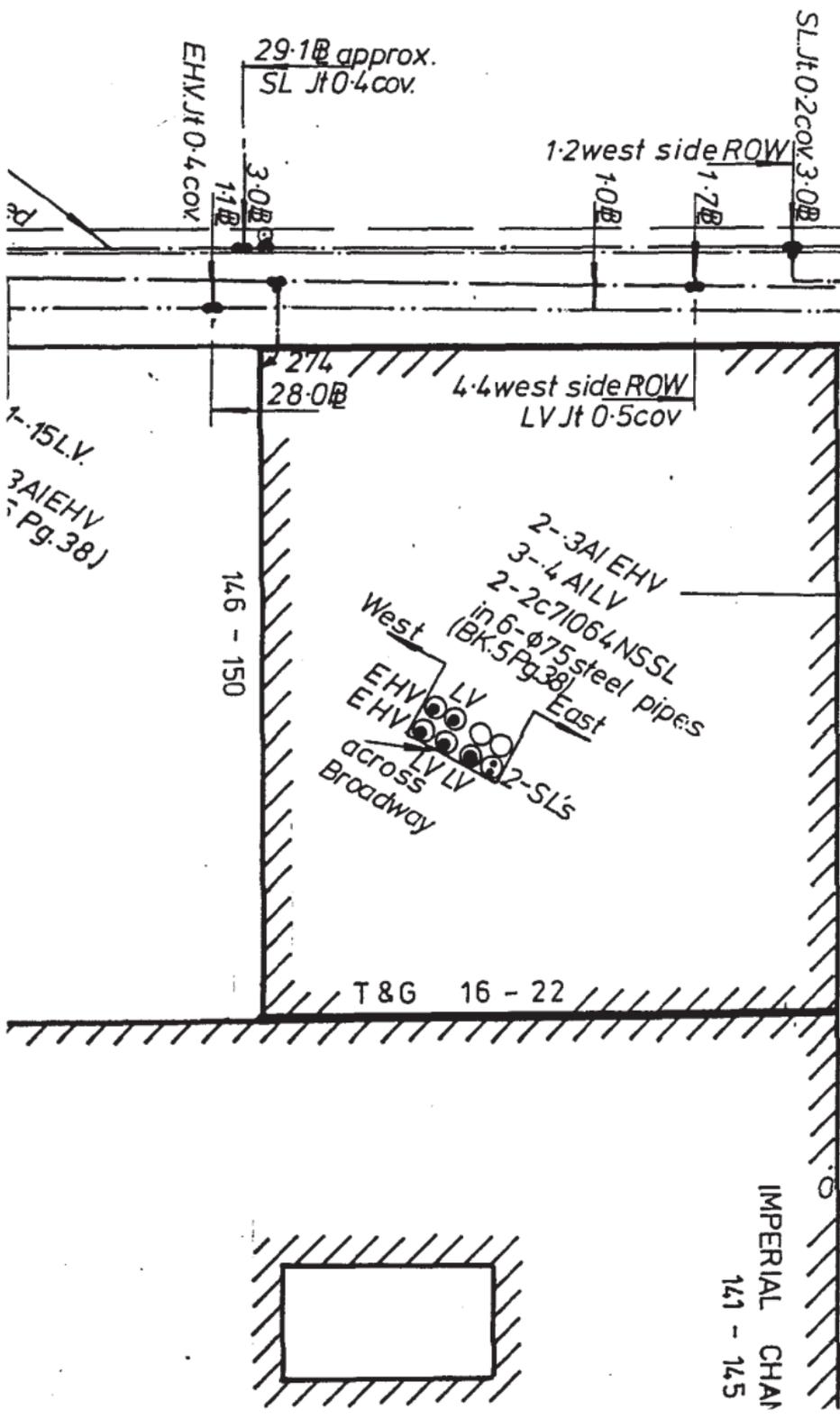


Figure 1 Electrical Plan

A V E N U E

1-4 AILV
1-2c71064NSSL
(BK.5 Pg.38)

1-1c71064NSSL
1-2c191052 abanc

L.V.Jt0.6cov1.6B
E.H.V.Jt0.5cov

0.9B

1.0B

275D

275D

2.9 east side R.O.W.

2.4 west side R.O.W.

0.4 cov.

275

2.6 west side R.O.W.

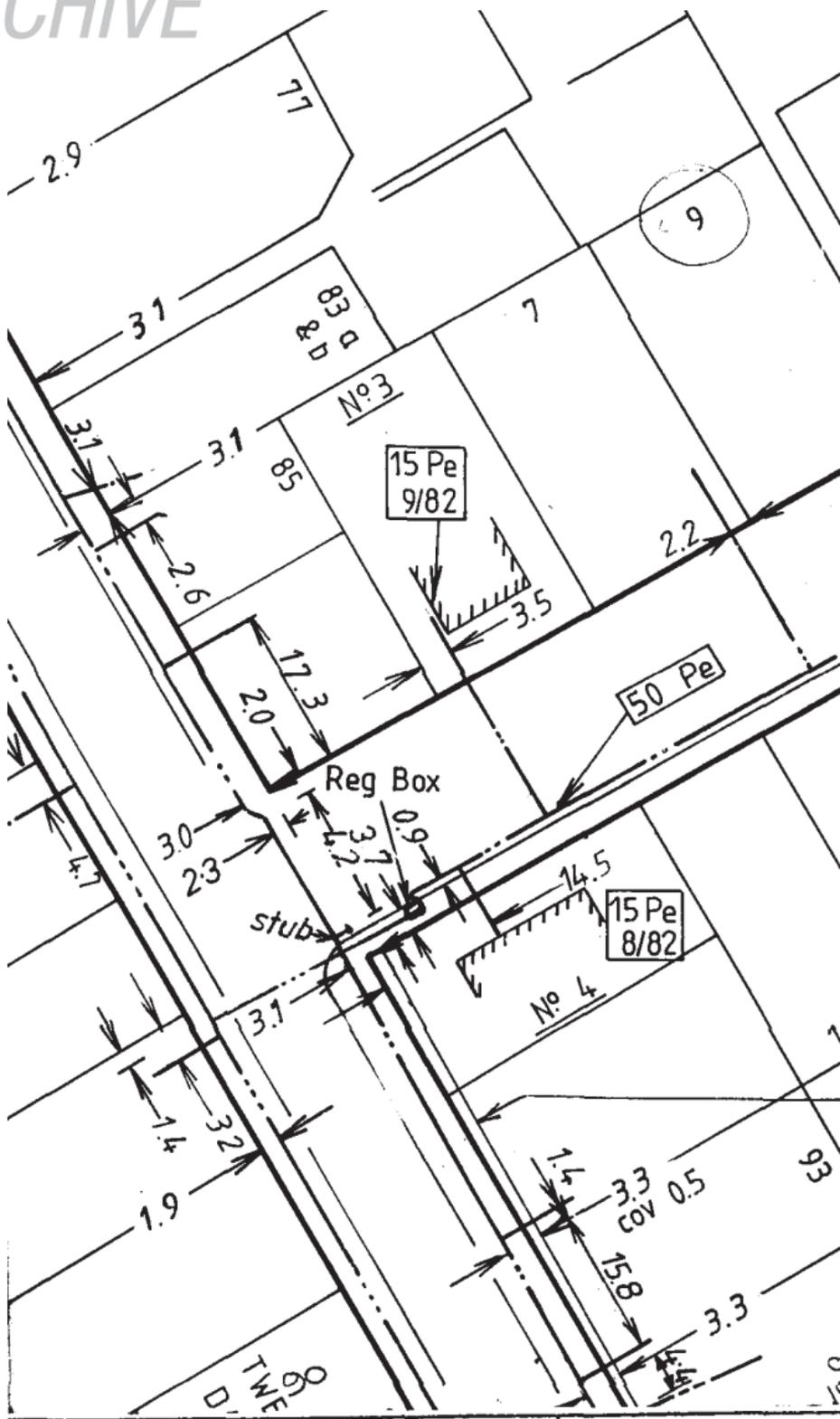
4 cov

26.2B

4.1 sub
0.5 cov

AMP BUILDING
26 - 36

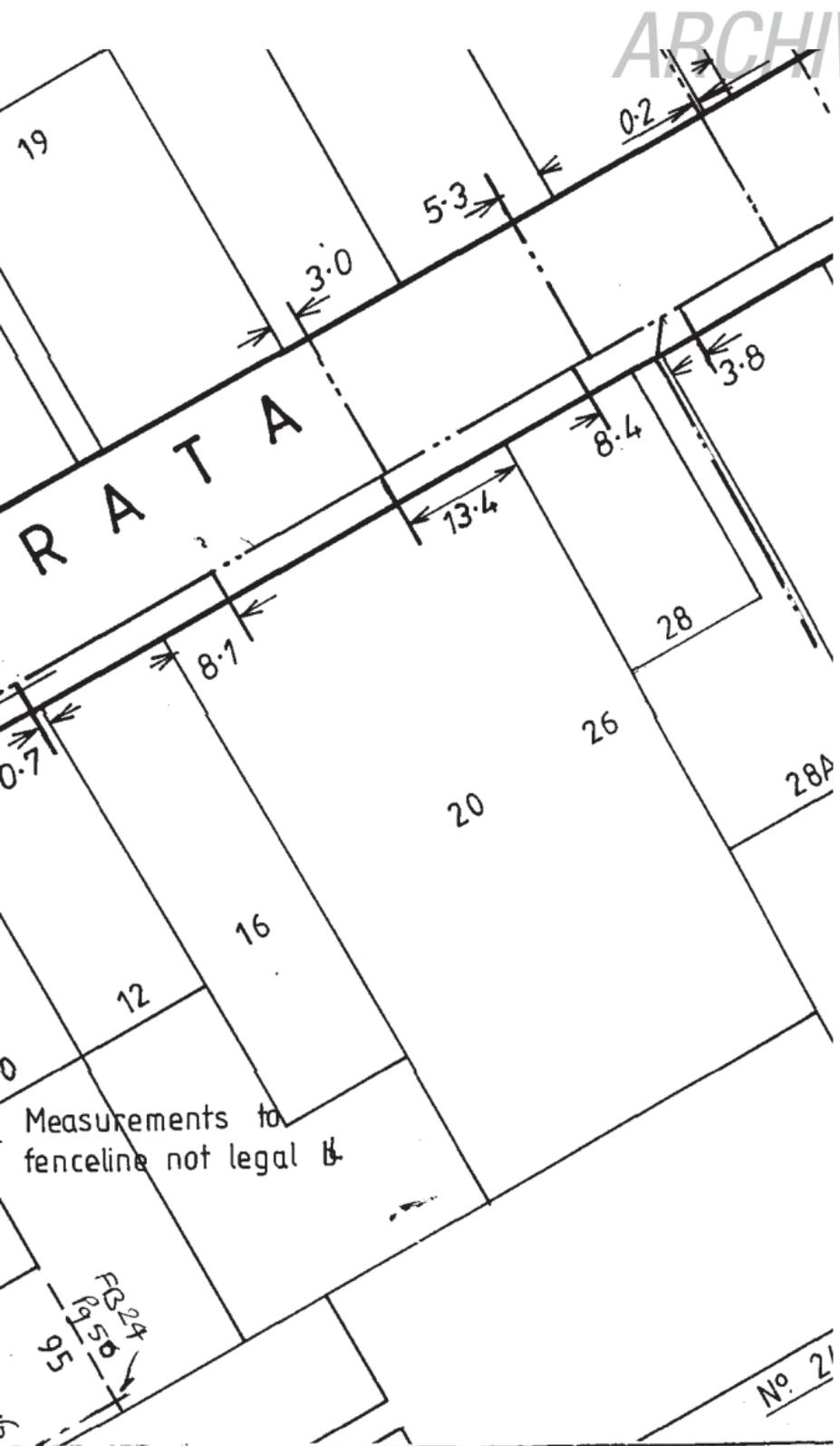
G77



Contact Gas Over
assist with pipe loc
prior to excavati
necessary.

This plan to be
on site for refe

Figure 2 Gas Plan



Measurements to fenceline not legal

FGS 274
5.9

No. 21

seer to
location
on if

available
reference.

Contact Gas Overseer for location of High Pressure mains. Overseer to be on site during excavation within 1 meter of this pipe. 24 hours notice Please.

GAS PRESSURE
 --- Lc
 - - - - M
 - - - - H

SCALE: 1:1000

DATE: 6/10/93

SIGN: [Signature]

(Service owners will need to be consulted prior to information being transferred from original plans to working plans. In all cases it is important for all plans to be held on site.)

- 20** Even when work has to start without plans, as may be the case for emergency and unforeseen work, every effort should be made to locate buried services and possible owners should be consulted. In the meantime it should be assumed that buried services are present and digging should proceed with extreme caution, and only after a locator has been used to detect metallic cables and pipes. It is particularly important that anyone carrying out excavations in such circumstances should be adequately trained and supervised.

(Where plans are not available in any situation, hand digging only should be carried out.)

Cable And Pipe Locating Devices

- 21** The position of any services in or near the proposed work area should be pinpointed as accurately as possible by means of a locating device, in conjunction with any available cable plans or other suitable information (see Figure 2). Plans will help the operator using the locator to interpret the signal, and so give the maximum information to those involved with the work before digging starts.
- 22** Various locators are available, and guidance on their selection and use should be in accordance with the manufacturer's instructions. The main types of locator available can be classed as follows:
- (a) *Hum Detectors*: These are receiving instruments which detect the magnetic field radiated by live electricity cables which have a current flowing through them. They will not detect, for example, service connection cables to unoccupied premises or street lighting cables in the daytime, because little or no current is flowing.
 - (b) *Radio Frequency Detectors*: Receiving instruments which respond to low-frequency radio signals, which may be picked up and re-emitted by

cables and long metallic pipes. If radio frequency detection is used, other metallic objects may re-radiate the signal and results may vary appreciably according to locality, length of the buried cable or pipe and distance from the termination, and geographical orientation.

- (c) *Transmitter-Receiver Instruments:* A small portable transmitter or signal generator can be connected to a cable or pipe, or placed very close to it so that the signal is induced into it. The receiver can then detect this signal. Usually some part of the cable or pipe needs to be already known so that the transmitter can be properly positioned, and these locators generally require more skill to operate than other types. They can, however, provide useful information in difficult situations where the techniques in (a) and (b) have not been successful.
- (d) *Metal Detectors:* Conventional metal detectors will usually locate flat metal covers, joint boxes, etc, but may well miss round cables or pipes. They can be a useful tool for finding inspection points which may provide connection points for a transmitter.

Some commercially available instruments use more than one of these techniques and may include a depth measuring facility.

- 23** The degree of confidence with which buried services can be detected depends on a number of factors such as the characteristics of the device being used, the type and depth of the service, the magnitude of the current carried by the cable, effects of other cables and metal pipes close by, and the training, skill, hearing and experience of the operator. *In particular, a locator may not be able to distinguish between cables or pipes running close together and may represent them as a single signal.* If two are sited one above the other it may not detect the lower one. Having dug and found one cable or pipe does not mean that there is not another close by. *Frequent and repeated use should be made of locators during the course of the work.* Locators will not detect plastic pipes or other non-metallic ducts and services unless either:
- (a) A metallic tracer wire has been laid with the pipe. This enables a signal transmitter/receiver to be used. Plastic gas and water pipes are the non-metallic services most likely to be encountered and few have been laid with metallic tracer wires in the past.
 - (b) A small signal transmitter is inserted into and pushed along the pipe. This is a sophisticated technique which is not likely to be appropriate for most jobs.
- 24** Locating devices should always be used in accordance with the manufacturer's

instructions and should be regularly checked and maintained in good working order. The line of any identified services should be noted and marked with waterproof crayon, chalk or paint on paved surfaces (any residual markings being erased after excavation as far as possible) or with wooden pegs in grassed or unsurfaced areas. Steel pins, spikes or long pegs, which could damage services laid at shallow depth, should not be used.

Safe Digging Practice

- 25** Once a location device has been used, excavation may proceed, with trial holes dug using hand tools as necessary to confirm the position of any buried services. Special care should be taken when digging above or close to the assumed line of such a service. Hand-held power tools and mechanical excavators are the main causes of danger and they should not be used too close to underground services. Advice on appropriate safety margins from electricity cables and gas pipes is given in Appendices 1 and 2.
- 26** Incorrectly used hand tools are a common source of accidents but when carefully used they can normally provide a satisfactory way of exposing buried services, once the approximate positions have been determined using plans and locators. Every effort should be made to excavate alongside the service rather than directly above it. Final exposure of the service by horizontal digging is recommended as the force applied to hand tools can be controlled more effectively. In particular:
- (a) Spades and shovels should be used rather than other tools. They should not be thrown or spiked into the ground, but eased in with gentle foot pressure.

- (b) Picks, pins or forks may be used with care to free lumps of stone, etc. and to break up hard layers of chalk or sandstone.
 - (c) Picks should not be used in soft clay or other soft soils near to buried services.
- 27 Particular care is necessary when gas leak search techniques such as barholing are used.
 - 28 Once underground services have been uncovered, failure to identify them correctly is another common cause of accidents. A wide variety of materials and colours has been used by the utilities over the years.
 - 29 Water pipes, electricity cables and telecommunication cables may be of black plastic and if any black plastic service is found, it should be assumed to be a live electricity cable until proved otherwise. Some services run in ducts, making them difficult to identify. *Where there is any doubt about the identify of an exposed service, it should be treated as an electricity cable or gas pipe until proved otherwise.* All services should be assumed to be live until disconnected and proved safe at the point of work. Obtain written confirmation of disconnection from the service owner before removing a redundant service.
 - 30 To establish uniform surface marking of underground services, it is recommended that controlling authorities use the

following symbols and colours:

Electricity	“E”	red
Gas	“G”	yellow
Oil	“O”	none
specified		
Water	“W”	green
Foul Sewer	“SS”	green
Storm Water or Drainage	“SW”	green
Telecommunications	“T”	blue/green

- 31 It is important to remember that colours may look different under poor or artificial lighting and that ducts may well contain any one of the services, irrespective of the type or colour of the duct.
- 32 Services uncovered in an excavation may need to be supported (see Appendices 1, 2 and 3). Backfilling of any excavation, where services have been disturbed should only proceed following advice from the service owner. Any fill containing items likely to damage the services, such as large pieces of rock and hardcore, should not be used. For specific advice on backfilling in the vicinity of gas pipes (where long-term damage is a particular hazard) see Appendix 2. Other utilities can give advice on how to backfill trenches in which their services have been exposed.
- 33 If buried services have been found to be too shallow, or if the plans or other information have proved to be inaccurate, the owners should be informed, preferably

before the excavation is backfilled, to allow them to be relaid at the correct depth and the services records amended accordingly.

- 34** If a buried service suffers damage, however slight, the owner should be informed immediately and, in the case of electrical cables, gas pipes or high-pressure water mains, arrangements made to keep people well clear of the area until it has been repaired or otherwise made safe by the owner.

Safe Systems Of Work For Trenchless Methods

- 35** Trenchless methods are increasingly being used for laying and renovating buried pipes and cables, particularly where there is a need to avoid surface disruption. The most widely used techniques are impact moling, pipe bursting and directional boring. Care should be taken when using trenchless methods to avoid colliding with, and thereby damaging, other services. With moling and pipe bursting it is also important not to come too close to adjacent services, as displaced soil may damage or enter nearby pipes or ducts.
- 36** Plans, locators and trial excavations should be used to locate existing services in the same way as for traditional excavation methods. However, these clearances may need to be varied taking into account such factors as the construction of adjacent plant, ground conditions, bore diameter, the accuracy and reliability of the technique/equipment being used, and whether the other plant is parallel or crossing the proposed line. Moles are prone to deflection from their original course, and if there are existing services in the vicinity a mole tracking device should be used.

New Housing Developments

- 37** Underground services within the confines of partly completed housing developments are especially prone to damage from the numerous site operations that have to be carried out. A common trench may help to control the position and separation of underground services. Where buried services are laid on partly developed sites, special arrangements may be necessary for their temporary protection at vehicle and mobile plant crossing points.
- 38** Close liaison should be maintained between the developers, their contractors, and the utilities. A marked-up plan of the development showing the up-to-date position of buried services (including any variations from planned routes) should be kept on site by the builder/developer for the information of those involved in excavation and groundwork.

Builders and developers should supply the service owner with copies of as built plans.

Installation Of New Services Near Existing Services

- 39** New underground services often have to be laid in ground which contains existing services. Where it is reasonably practicable to do so, the utility planning the new installation should aim to site it so that it is separated from all existing buried services.
- 40** Where there is any congestion and doubt regarding separation, the excavator should contact the owner of the services in the vicinity to discuss both horizontal and vertical clearances.
- 41** Where the utility which is laying the new buried service has to reduce the separation, it should inform the utility whose service has been affected. This will enable them to amend their records for future reference.

Demolition Sites

- 42** Special problems can arise in the case of service terminations in derelict property or on demolition sites. Section 32 of the Building Act makes it unlawful for buildings to be demolished without obtaining a building consent. Part of this process involves input from the various utilities on the presence of their services, etc.
- 43** Buried services on industrial or commercial sites may be owned by the site occupier. A contractor who is to demolish buildings or plant on such a site should contact the services owner, whether this is the site occupier or the site owner, to ensure that all relevant services are isolated before work starts.

Appendices

Appendices 1 to 4 give advice on matters which relate particularly to each of the four main types of underground service. *It is additional information and should be read and used in conjunction with the advice contained in the main text.*

Appendix 1: Electricity Cables

Plans

- 1 Cables under the highway may belong to bodies such as the highway authority, the street lighting authority, Electricorp, Ministry of Defence, New Zealand Railways or other private companies. Such owners should be traced and consulted wherever possible.
- 2 Figure 2 (pages 22 to 23) shows an example of an electrical cable plan. Note, however, that symbols may vary from one electricity distributor to another. Advice should be sought from the issuing office. Remember that low- and high- voltage cables may be shown on separate plans.

Cable Locating Devices

- 3 Hum detectors are simple to use, but they do not respond to unloaded or direct current cables and they may fail to detect lightly loaded low-voltage cables (such as those used for street lighting) or well balanced high- voltage cables. A locator with a radio frequency detection mode may detect these cables and should be used as a back-up check. It should be noted that street light cables will not

normally be energised during the day.

- 4 Even where the locator gives no indication, there may still be cables present, and any cable uncovered may still be live.
- 5 If a cable recorded on the cable owners plan cannot be located, appropriate assistance or advice should be sought. If digging has to start before such assistance or advice has been obtained, extreme care should be taken.

Safe Digging Practice

- 6 In most cases there will be no permanent surface marker posts or other visible indication of the presence of a buried cable. Even if no cables are shown on plans or detected by a locator, a close watch should be kept for any signs which could indicate their presence.
- 7 Underground cables are normally laid in trenches between 300mm and 1m deep, but they can often be found just below the surface. This should always be borne in mind, particularly if the ground has been disturbed or if there are cellars or structures such as bridges in the area which may have prevented cables being laid at standard depths. Even shallow excavations (e.g. for post holding and fencing work) may be hazardous.
- 8 Cables may have been laid directly in the ground with a bed or surround of fine soil or sand, or in cement-bound sand, or in

asbestos cement or plastic pipes or ducts, or they have a layer of tiles, slabs or coloured plastic marker tape laid above them. However, such protection may have been disturbed and moved and should not be relied upon to give an accurate indication of a cable position. Although high-voltage (HV) cables may have marker tapes laid over them, low-voltage (LV) cables may be laid without separate protective cover. This emphasises the importance of safe digging practice.

- 9 Occasionally, cables are terminated in the ground by means of a seal, sometimes with external mechanical protection. These 'pot-ended' cables should be treated as live and should not be assumed to be abandoned or disused.
- 10 Using hand-held power tools to break up paved surfaces often leads to accidents. Where practicable, such power tools should not be used within 0.5m of the indicated line of a cable buried in or below a paved surface. When power tools have been used to break the surface away from the indicated line of the cable, it should then be positively located by careful hand digging under the paved surface. The paved surface should be gradually removed until the cable is exposed. If the cable is not so exposed, then it must be assumed to be embedded within the paved surface. Where possible, a cable locator should be used as a depth guide down the side of the excavation. The 0.5m safety margin may be reduced:

- (a) Where congestion of buried cables renders it impracticable; or
- (b) Where surface obstructions limit the space available;

but only if the line of the cable has been positively identified by plans and confirmed by a locator. Because of the difficulty in confirming depth, hand-held power tools should never be used over the cable unless either:

- (a) The cable has already been exposed by digging under the surface to be broken out and it is at a safe depth, (at least 300mm) below the bottom of the hard surface material; or
- (b) Physical precautions have been taken to prevent the tool striking the cable. Advice on the safe use of hand tools is given in paragraph 26 of the main text.
- (c) The cable has been confirmed as abandoned and safe by the owner.

- 11** During digging work, a careful watch should be kept for evidence of cables, and repeat checks made with a locator to determine more precisely the position of any cable as signals become clear. Remember that a cable is positively located only when it has been safely exposed, and even then, digging should still proceed with care: there may be other cables, particularly HV cables, adjacent or lower down.
- 12** Where mechanical excavators are used in the possible vicinity of underground

cables, the work should be arranged so that damage to cables is avoided , and so that everyone is kept well clear of the excavator bucket while it is digging.

If a cable is struck, the driver should stay in the cab. If it is necessary to leave the cab, the driver should jump clear and not climb down, to avoid being electrocuted. A watch should be kept on the machine and no one should go down into the excavation or touch the mechanical excavator or the cable until the cable owner has made the damaged cable safe. (Excavator operators should also be aware of overhead power lines and the required safe operating distances).

- 13** Where it is necessary to break away or disturb concrete in which a cable is embedded, either the local electricity distributor should be asked to de-energise the cable or an alternative safe method of excavation agreed with the electricity distributor or other owner of the cable before work starts. Excavations can proceed safely only after a buried cable has been de-energised and where permits to work or other safety documents are used. Liaison should be maintained between the parties involved to ensure that work covered by the permit is completed, and workers are clear, before the circuit is re-energised.
- 14** Accidents sometimes occur after underground cables have been exposed. Cables should not be used as hand or foot holds by anyone climbing in or out of the

trench. Where a cable exposed for more than 1m crosses a trench, the owner should be asked to provide support.

Any cables lying in the bottom of an excavation should be protected by nail-free wooden planks, troughing, sandbags or other suitable means, but care should be taken not to use materials or equipment which could damage or penetrate the outer sheath of cables. Cables should not be moved aside unless the operation is supervised by the cable owners.

Precautions should be taken to prevent access to exposed cables by children or other unauthorised people.

- 15** Hard or sharp material such as pieces of rock, large stones, hard-core or surplus concrete, should not be tipped into open cable trenches. Advice on backfilling cable trenches can be obtained from electricity distributor
- 16** Where the owner of the underground service supplies information or locates a service some time in advance of the excavation, a further check should be made to ensure that the information is still valid at the time the work commences.

Appendix 2: Gas Pipes

- 1 Most underground gas pipes belong to local gas distributors who may service cities and towns within their distribution area.

The most important exception to this is the Natural Gas Corporation Transmission Division, which owns and operates three thousand kilometres of high-pressure gas pipelines throughout the North Island.

Plans

- 2 On request, the local gas distributor will give approximate locations of gas pipes, usually in the form of plans. It should be noted that plans of underground gas pipes may not show the position of service connections. Their existence should not be assumed. Details on the location of service connections are available from the gas distributor. Early contact, preferably at the planning stage, is beneficial and will allow full discussion of proposals to ensure the safety of plant and operators.

Pipe Locators

- 3 Locators of the radio frequency detection or the transmitter/receiver types should be used to help locate metallic gas pipes before excavation. Polyethylene (PE) pipes in some distribution systems have a

tracer wire attached to them to facilitate location by a proprietary locator. However, this is not always the case and care must always be taken.

Safe Digging Practice And Avoidance Of Long-Term Damage

- 4 The depth of cover for gas mains laid in a roadway is normally 750mm, and for those laid in a footway 600mm. The depth of cover for gas service connections is normally 450mm in both road and footways. However, at entry positions to buildings, the depth of cover for the service connection may be 375mm.

Remember that these depths are only a guide and pipes may be found at shallower depths. The depth of cover may for example have been reduced since the pipe was installed, perhaps because other works (such as road alterations) have been carried out in the area. Pipes passing over cellars or in the vicinity of bridge structures may have to be laid at shallower depths. Transmission pipelines are installed with a depth of cover of 900mm.

- 5 Gas pipes are laid directly in the ground, although in certain soils selective backfill may have been used as a bed and pipe surround may be inserted into suitable ducting on new housing estates. Marker tape is generally placed above PE and

steel gas pipes. The presence of gas plant may also be indicated by valve boxes and marker posts.

Marker posts/plates are sometimes used to indicate the position and size of valves or siphons on gas mains. However, such markers may have been disturbed and should not be relied upon as an accurate indicator of position.

- 6 All gas pipes should be located by hand digging before mechanical excavation begins. This is particularly important for service connection pipes, which may not be marked on plans. A suitable hand digging method is to dig a trial trench along the road near the kerb, or in the footpath, where the service connection pipes are likely to be at their most shallow. When the positions and depth of the pipes have been determined, work can proceed.
- 7 The danger created by damaging a gas pipe with an excavator is much greater than if the damage is done with a held-held power tool (the opposite is true for work near electricity cables and this is reflected in the different safe digging practices). Gas pipes may have projections such as valve housings, siphons and stand pipes which are not shown on the plans and to allow for this mechanical excavators are not to be used within 0.5m of a gas pipe. Greater safety distances may be advised by the gas authority or owner depending on mains pressure.

- 8 Hand-held power tools can damage buried gas pipes and should be used with care until the exact position of a buried pipe has been determined. They may be used to break a paved or concrete surface above a gas pipe, unless there are any indications that the pipe is particularly shallow or close to the surface to be broken up.

Permits To Work

- 9 A written permit setting out the minimum safety conditions may be required for such work as: construction of buildings, placement of fence posts, drain construction and cleaning, any excavation, any permanent service, removing earth cover, blasting, operating heavy machinery over a pipeline, or any work which could damage or endanger the pipeline.
- 10 If a gas escape is suspected, the following action should be taken immediately:
 - (a) *Remove all people from the immediate vicinity of the escape.* If the service connection to a building or the adjacent main has been damaged (see note below), warn the occupants to leave the building, and any adjoining building, until it is safe for them to return.
 - (b) Inform the local gas supply authority (or other owner as appropriate) by telephone.
 - (c) Prohibit smoking; and extinguish all

naked flames and other sources of ignition, within at least 5m of the leak.

- (d) If a gas escape is substantial, telephone the Fire Service.

It is important to note that a mechanical excavator may not only cause damage/leakage at the point of impact. For example, damage to a service connection outside the building may result in further, unseen damage to the connection inside the building. Gas escaping from the damage inside, or gas travelling along the line of the service connection pipe from outside the building, may cause a build-up of gas within the building.

- 11** No manhole, chamber or other structure should be built over, around or under a gas pipe and no work should be carried out which results in a reduction of cover or protection over a pipe, without first consulting the owner.
- 12** Where gas pipes cross or are parallel and close to excavations, changes in backfill etc. may cause differential ground settlement and increased stress in the pipe. For pipes parallel and close to excavations, the degree of risk depends upon the depth of the excavation, the distance of the pipe from the excavation, and the type of soil. Wherever an excavation may have affected support for a gas pipe, the owner should be consulted. In some cases it may be necessary to divert the gas pipe before work begins.

- 13** Where an excavation uncovers a gas pipe, the backfill should be adequately compacted, particularly beneath the pipe, to prevent any settlement which would subsequently damage the pipe. Backfill material adjacent to gas plant should be selected fine material or sand, containing no stones, bricks or lumps of concrete, etc, and should be suitably compacted to give comparable support and protection to that provided before excavation. No power compaction should take place until 200mm cover of selected fine fill has been suitably compacted.
- 14** If the road construction is close to the top of a gas pipe, the owner should be asked about necessary precautions. The road construction depth should not be reduced without permission from the local Roading Authority.
- 15** No concrete or other hard material should be placed or left under or adjacent to any gas pipe as this can cause pipe fracture at a later date. Concrete backfill should not be used within 300mm of a gas pipe.
- 16** Where an excavation uncovers a steel gas pipe with a damaged wrapping, the owner should be told, so that repairs can be made to prevent future corrosion and leakage.
- 17** Pipe restraints or thrust blocks close to gas mains should never be removed.
- 18** Anyone who carries out work near underground gas plant should observe any specific requirements made by gas staff,

and ensure that access to the plant by those staff is available at all times. No unauthorised repairs to gas pipes should be made. If in doubt, seek advice from the local gas authority. The addresses and telephone numbers for all emergencies and enquiries can generally be found in the telephone directory under 'Gas'.

Appendix 3: Water Pipes And Sewers

- 1 In general, work near underground water pipes is of low risk. Most precautions are concerned with reducing the cost of damage than with eliminating hazard. There are some dangers, however, and the following precautions should be taken:
 - (a) Where work is carried out near high-pressure mains, plans should be obtained from the relevant local authority and, where possible, a pipe locator used. Safe digging practices should be followed, using hand tools as far as is practicable.
 - (b) At bends in mains, concrete thrust blocks may be used. Under no circumstances should either thrust blocks or the ground supporting them be disturbed, as this can cause sudden failure of the main.
 - (c) Exposed water pipes should be supported as necessary and the correct method of backfilling used. For advice, contact the relevant local authority.
 - (d) If a water pipe or its wrapping is damaged, the relevant local authority and the owners of any other underground services which may be

affected should be informed immediately.

Appendix 4: Telecommunications Cables

- 1 It is important for contractors to be aware of the hazards associated with damaged fibre optic cables, also to ensure that they obtain accurate information about the location of fibre optic cables prior to any excavation work being commenced. Telecom staff are available to provide this information and mark the actual location of their cables. Contact:
Telecom Cable Locations
Freecall: 104
for advice and information on the location of cables in your area.
- 2 Contractors should be aware that cables containing optical fibres carry light signals generated by Class 3B lasers, which means that exposure to the beam may be harmful to the body, particularly the eyes and skin. A 5-second ocular exposure at a distance of 110 mm or less can cause damage to the eyes or skin. These lasers operate in the infra-red region and the light they give out is not visible to the naked eye.
Although the level of laser signal at the

broken end of a fibre optic cable will depend on the laser transmission power and distance from the laser transmitter, the following safety rules should be observed:

- (a) Never look directly at any fibre end of a broken fibre optic cable.
- (b) Never point the fibre end of a broken fibre optic cable at anyone else.
- (c) Preferably, do not handle broken fibre optic cable and stay at least one metre away away from the broken end of the cable.
- (d) Treat all fibre optic cables as carrying laser-generated signals at all times.

Appendix 5: Legislation Relating To Underground Services

Health and Safety in Employment Act 1992

Preamble: An Act to reform the law relating to the health and safety of employees, and other people at work or affected by the work of other people.

General Duties of Employers —

(Section 6) Employer must take all practicable steps to:

- (a) Provide and maintain a safe working environment.
- (b) Provide facilities for the safety and health of employees.
- (c) Ensure equipment is arranged, designed, made and maintained to be safe for employees to use.
- (d) Ensure employees are not exposed to hazards arising from operations in or near their place of work.
- (e) Develop procedures for dealing with emergencies.

Identification of Hazards — (Section 7) Employer to ensure there are in place effective methods for:

- (a) Systematically identifying hazards to employees (existing and new).
- (b) Regularly assessing each hazard identified and determining whether or not it is significant.

Employer must also investigate accidents to determine whether they were caused by a significant hazard.

Control of Hazards — (Sections 8, 9, 10)

Employer is to *eliminate* significant hazards.

If this is impracticable, the hazard to be *isolated*.

If this is impracticable, the hazard is to be *minimised*,

- the employee protected,
- exposure to hazard monitored,
- employees' health in relation to hazard to be monitored.

Duties in Relation to Information — (Sections 11, 12) Employees are to be given information on:

- Results of hazard and health monitoring,
- Emergency procedures,
- All hazards employee may be exposed to,
- Steps taken to reduce those hazards,
- Location of safety equipment.

Training and Supervision — (Section 13)

No employee is to undertake any work unless:

- (a) Employee has sufficient knowledge and experience to ensure no one is at risk of harm; or
- (b) Employee is supervised by a competent person; or
- (c) Employee is adequately trained.

Employees to be Involved — (Section 14) Employer is to ensure that employees have the opportunity to be fully involved in the development of safety procedures.

General Duties of Employers — (Section 15) Employer is to take all practicable steps to ensure the action or inaction of an employee does not harm any other person.

Person with Control of Place of Work — (Section 16) A person who controls a place of work shall take all practicable steps to ensure the people in or near the place of work are not harmed by a hazard arising in the place of work.

Contractors and Subcontractors — (Section 18) The principal shall take all practicable steps to ensure no contractor or subcontractor is harmed while doing any work that the contractor was engaged to do.

Duties of Employees — (Section 19)

Employee to take all practicable steps to ensure:

- (a) The employee's own safety;
- (b) No action or inaction causes harm to any other person.

Excavation Guide 1988

Underground Services

- (a) Because of the many services such as electric power cables, telegraph cables, gas pipes, water pipes, oil pipes and sewer reticulation that are located underground, employers must, before starting work, ascertain the location and nature of all services that are likely to be affected by the excavation. The controlling authorities of these respective services must be advised and their assistance sought.
- (b) When the existing services are uncovered during excavation, proper supports must be provided and every precaution must be taken to prevent danger to workers or unnecessary interruption to these services. Suitable warning notices must be erected to warn workers and persons lawfully in the vicinity.

Electricity Act 1992

Preamble — An Act to consolidate and amend certain enactments relating to the generation and sale of electricity; and for

other purposes.

This Act is administered in the Ministry of Commerce.

PART IIIA : ELECTRICAL CODES OF PRACTICE

Electrical Code defined: In this Act the expression 'electrical code ' means an instrument, order, or requirement for the purposes of, or relating to:

- (a) The setting or endorsing of standards or specifications concerning the design or construction or installation or importation or manufacture of electrical equipment, appliances, apparatus, materials, installation, or systems;
- (b) The operation or use of electrical equipment, materials, installations, or systems;
- (c) The inspection or maintenance of electrical equipment, materials, installations, or systems.
- (d) The safety of persons or property associated with or using electrical equipment, materials, installations, or systems;
- (e) The setting or endorsing of standards, controls, or requirements for any tree or vegetation to prevent the interruption of the supply of electricity or interference with the electrical supply system.

Electrical Code of Safety Practice for Electrical Supply Authorities in New Zealand

Underground Cables

9.1 Recording of Cable Locations

A record shall be kept by the electrical supply authority of the location of every underground cable laid by that authority or on behalf of that authority.

9.2 Excavations

Before commencing trenching and excavation work, the supervisor and foreman must ensure that the location of all underground services is known and that the Labour Department Safety Inspector [Health and Safety Inspector] has been notified if the work is notifiable under the Construction Regulations.

9.2.1 Trenches more than 1.5 metre deep may be notifiable under the requirements specified in the Construction Regulations and may have to be timbered.

9.4 Identification of Cable

Work shall not be commenced on any underground cable until the identity of the cable has been established and the appropriate precautions taken as set out in 9.10, 9.11, 9.12 and 9.13. The cable shall be identified by one of the following methods.

9.4.1 Cables connected to the system.

9.4.1.1 By physically tracing the exposed

cable from one termination to the point of work.

9.4.1.2 By the use of a suitable electrical identifying test, such as a trace signal applied at the termination and identified at the point of work.

9.4.1.3 By the use of reliable cable records, followed by earthing using a spiking device.

Precautions must be taken to prevent relivening the cable after spiking in case an error has been made in identification. After the cable has been cut and before any further work is carried out, it must be identified by a suitable electrical test from the termination to the point of work.

9.4.1.4 By the use of reliable cable records. This method only applies to l.v and m.v cables on which live jointing techniques are to be used. Care must be exercised while opening the cable in case an h.v, e.h.v or d.c cable is opened due to an error in identification.

Paragraphs 9.10, 9.11, 9.12 and 9.13 relate to the precautions when working on any live l.v or m.v cable.

Gas Act 1992

Preamble: An Act to make better provision for the regulation, supply, and use of gas in New Zealand.

This Act is administered in the Ministry of Commerce.

Section 46 Safety requirements for

distribution systems, etc. requires —

All distribution systems, gas installations, fittings and gas appliances shall be of such quality and standard and shall be constructed, maintained, and operated in accordance with safety requirements prescribed by regulations made under this Act or, in the absence of regulations or insofar as the regulations do not extend, approved by the Chief Inspecting Engineer (Gas).

NZS 5258:1989 Gas Distribution

(Note: This document is being revised)

4.1.6

Cover requirements

4.1.6.1

Reduced cover:

Buried pipelines, and mains or service lines shall be installed under normal conditions with a cover not less than that specified in the following table. However, the cover over service lines inside properties not subject to vehicular loads may be reduced to a minimum of 300mm, where the service line is connected to a low- or medium-pressure main.

	<i>Consolidated rock</i>	<i>Carriageways</i>	<i>Footpaths Inside and berms property</i>	
<i>Minimum cover, mm</i>				
Mains:				
Low and medium pressure	500	600	600	
Intermediate pressure	600	900	900	
Services:				
Low and medium pressure		600	450	450
Intermediate pressure		900	600	450

4.1.6.2

Extra protection:

Where farming or other operations might result in deep ploughing or in areas subject to erosion or in locations where future grading is likely, such as at road, railway, highway and ditch crossings, additional protection shall be provided.4.1.6.3

Below minimum cover:

In locations where specified minimum cover cannot be provided or where external loads may be excessive, the pipeline, main or service line shall be encased, bridged or designed to withstand any anticipated external load.

4.1.7

Clearance from other underground structures

4.1.7.1

Minimum clearance for IP pipelines:

There shall be at least 300mm clearance wherever possible between any buried intermediate pressure pipeline, main or service and any other underground structure not used with the pipeline, main or service. When such clearance cannot be attained, precautions, such as the installation of casing, bridging or insulating material, to protect the pipe shall be taken.

4.1.7.2

Minimum clearance for LP and MP pipelines:

The clearance between any low or medium pressure system and any other underground structure shall be sufficient to allow proper maintenance and to protect against damage that may result from proximity to the other structure. The minimum clearance, either horizontally or laterally around the circumference of the pipe, shall not be less than 150mm. For parallel services, the minimum horizontal clearance shall be not less than 150mm.

4.1.8

Installation of pipe in the trench:

It is important that laying stresses induced in the pipeline by construction be minimised. The pipe shall fit into the trench without the use of external force to hold it in place until the backfill is completed. The trench shall be so graded

and/or the pipe so formed that it has a firm, substantially continuous bearing on the bottom of the trench. When long sections of pipe welded alongside the trench are lowered in, care shall be exercised so as not to jerk the pipe, or impose any stress that may kink or put a permanent bend in the pipe. Slack loops are not prohibited by this clause where laying conditions render their use advisable. The pipeline shall be bedded on rock-free material of sufficient thickness to prevent damage to the pipe or coating.

4.1.9

Backfilling:

Backfilling shall be done in a manner to provide adequate compaction around the pipe and to minimise subsequent soil movement, and comply with the relevant reinstatement specification. If the material to be used for backfill contains rocks or stones that may cause damage to the pipe or coating, care shall be taken to prevent such damage by using rock shield material, or by making the initial fill with rock-free material of sufficient thickness to prevent damage. If the trench is flooded with water to consolidate the backfill, care shall be exercised to see that the pipe is not floated from its firm bearing on the trench bottom.

4.1.10

Marker tape:

A marker tape shall be laid in open trench

excavations above the pipe to indicate the presence of a gas line to anyone excavating in the area. The marker tape shall be installed a minimum of 300mm above the pipe or no less than 150mm below the existing ground level.

4.1.11

Location aids:

For non-metallic systems electrically conducting plastic covered wire should be installed with the pipe to facilitate locating it with an electric locator. Other suitable material or means for accomplishing this purpose may be employed.

4.1.12

Pipe installation without open trench.

4.1.12.1

General:

Trenchless or partial excavation techniques as stated below may be specified for the installation of mains or service pipes. It is essential that investigations be undertaken to ensure that other utilities' plant is identified and accurately located and the nature of the subsoil determined to ascertain whether trenchless pipelaying is a viable option and which technique is applicable to the particular situation.

The various techniques available are:

- (i) unguided boring
- (ii) directional boring
- (iii) mole ploughing

(iv) auger boring

(v) insertion

4.1.12.2

Boring:

Use of a boring technique should be undertaken following approved procedures and the manufacturer's recommendations.

Local Government Act 1974

Preamble: An Act to consolidate and amend the law relating to the reorganisation of the districts and functions of local authorities, to make better provision for the administration of those functions which can most effectively be carried out on a regional basis, and to make provision for the establishment of united councils, regional councils, district councils, district community councils, and community councils, (and to consolidate and amend the Municipal Corporations Act 1954, the Counties Act 1956, the Local Authorities (Petroleum Tax) Act 1970, and provisions of other Act of (the Parliament of New Zealand) relating to the powers and functions of regional councils, united councils, and territorial local authorities).

This Act is administered in the Department of Internal Affairs.

Section 658 provides that—

- (1) Subject to this section, the council may

- (a) Enter into an agreement . . . for the conversion into underground lines of all existing above ground telephone lines in a defined part of the district;
- (b) Enter into an agreement with the appropriate Electrical Supply Authority under the Electricity Act 1968 for the conversion into underground lines of all existing above ground electric lines (as defined in the Electricity Act 1968) in a defined part of the district in respect of which the council is not the Electrical Supply Authority;
- (c) Convert into underground lines all existing above ground electric lines (as so defined) in a defined part of the district in respect of which the council is the Electrical Supply Authority.

Telecommunications Act 1987

Preamble: An Act to regulate the supply of telecommunication services and equipment and to provide for the licensing and regulation of radio apparatus.

This Act is administered in the Ministry of Commerce.

Appendix 6: First Aid

- 1 Burns are the main injuries that result from damage to live buried cables or from a fire or explosion following a gas leak. With electricity cable accidents in particular, they may be flash burns, spatter burns from molten metal and electrical burns. Direct electric shock is rare. In many cases the burns are made more severe by the fact that the injured person was working bare-chested*.
- 2 Workers should know how to give emergency aid until help arrives. Competence in cardio-pulmonary resuscitation and the immediate care of burns and unconsciousness would be an advantage. In remote locations it may be desirable to provide a means of communication, e.g. two-way radios, so that help can be quickly sought if there is an accident.
- 3 A casualty should not be moved unless in a position of danger. This is particularly important when the person has been

* Even ordinary work clothing can greatly reduce the severity of the burns and, of course, flame-retardant clothing is better. However, clothing made from man-made fibres such as nylon may melt and stick to the skin increasing the severity of the burns. This document offers no opinion on whether or when flame-retardant clothing should be provided or used. Employers should consider the matter with respect to their own circumstances. The wearing of flame-retardant clothing is no substitute for a safe system of work.

thrown some distance and may have suffered injuries in addition to burns. People giving first aid should take care not to touch any exposed cables or tools that may be live.

- 4 Striking a live buried cable may cause unconsciousness, and breathing and the heart may stop. Urgent action is needed. It is essential to establish a clear airway. Cardio-pulmonary resuscitation should be given as soon as possible by someone competent and trained to do so.
- 5 Electrical burns are deceptive. The underlying damage may be far more serious than appears on the surface. A sterile covering should be placed over the affected areas as soon as possible to reduce the risk of infection. All burn cases should receive professional medical attention. Urgent help is essential for severe burns, which can prove fatal.
- 6 A first aid container, or small travelling first aid kit (for those working in dispersed locations with no fixed accommodation or storage on site) should be provided with the standard contents as laid down in the First Aid Regulations under the Factories and Commercial Premises Act 1981. The quantities of equipment should be appropriate for the number of employees involved. Sterile triangular bandages and sterile dressings can be used to cover burns. A sterile, individually-wrapped paper disposable sheet or similar sterile covering may be

used for burns involving an extensive area.

- 7 All cases of injury resulting from an electrical accident should be referred for professional treatment.

Appendix 7: Work Procedures

Anyone who works near underground services (such as electric cables and gas pipes) should be properly trained in safe procedures. Information issued to employees can supplement this training and serve as a reminder of the main points. A suggested text is given on the following pages. It could be usefully adapted to meet the needs of individual organisations by adding supervisors' names, contact points, etc. It could be produced as a pocket card or leaflet, or in some other appropriate form.

Advice to Site Personnel When Working Near Underground Services

Underground services, particularly electricity and gas, can be dangerous. Damage to electricity cables can cause a flash, leading to severe burns or even death. Gas leaks can cause fire or explosion.

Damage can result from excavation or penetration of the ground, e.g. by a road pin.

Underground services may be found in roads, footpaths and on sites. Always assume that they are present. Treat any services found anywhere as LIVE.

Accidents have happened because people have mistaken one service for another. Check before you act.

Before Starting Work

- Make sure you have plans of the underground services in the area. This may not always be possible for emergency or unforeseen works. Remember that service connection cables and pipes from the main to a building or street light may not be shown.
- Use a cable and pipe locator to trace electricity cables and metal pipes. You

should have been trained how to do this. If in doubt, or if you have any difficulty, ask your supervisor for advice.

- Mark the positions of the cables and pipes using paint or other waterproof marking on the ground.
- Look for signs of service connection cables or pipes, e.g. a gas meter or service connection entry into a house or a street light.
- Hand dig trial holes (as many as necessary) to confirm the position of services in the area of your work. This is particularly important if there are plastic pipes, which cannot be found using a locator.

When You Start Work

- Wherever possible, hand dig near buried services. Spades and shovels are safer than picks, pins or forks.
- Check that any cable which is embedded in concrete and has to be broken out has been made dead before work starts, or that another safe way of working has been agreed with the energy distributor.
- Watch out for signs of services as work continues.
- Backfill around services with a fine material. **DO NOT** use rocks, bricks, mass concrete or similar material.
- Report any damage to a cable, pipe or pipe coating. Even if there is no immediate danger, damage could lead to danger at a later date.

- Do not use hand-held power tools within 0.5m of the marked position of an electricity cable (unless the number of services present makes it impossible, or surface obstructions reduce the space available).
- Do not use hand-held power tools directly over the marked line of a cable unless:
 - You have already found the cable at that position by careful hand digging beneath the surface and it is at a safe depth (at least 300mm) below the bottom of the surface to be broken; or
 - Physical means have been used to prevent the tool striking it.
- Do not use a mechanical excavator within 0.5m of a gas pipe. If an excavator is used near an electricity cable, keep everyone clear of the bucket while it is digging.
- Do not use exposed services as a convenient step or hand-hold.
- Do not handle or attempt to alter the position of an exposed service.
- Do not install plant close to an existing service. Ask your supervisor to tell you what the separation should be.
- Do not build existing services into a manhole or other structure, or encase them in concrete.

If You Suspect A Gas Leak

- Remove everyone from the immediate area of the escape. Remember that if a service connection to a building has been

damaged, it may cause a leak in the building. Warn the occupants of the building, and of the adjoining buildings, to leave.

- Telephone the local gas authority immediately.
- Ban smoking and naked flames within 5m of the leak.
- Assist the gas authority, police or fire services as requested.

REMEMBER, IF IN DOUBT, ASK.

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- New Zealand Standard 5258:1989 Gas Distribution (under revision)
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- Electrical Code of Safety Practice for Electrical Supply Authorities in New Zealand*
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- Department of Labour. *Excavation Guide* 1988.
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