HEALTH AND SAFETY AUTHORITY

Code of Practice

for

Avoiding Danger from Underground Services

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CODE OF PRACTICE FOR AVOIDING DANGER FROM UNDERGROUND SERVICES

(First Edition - February 2005)

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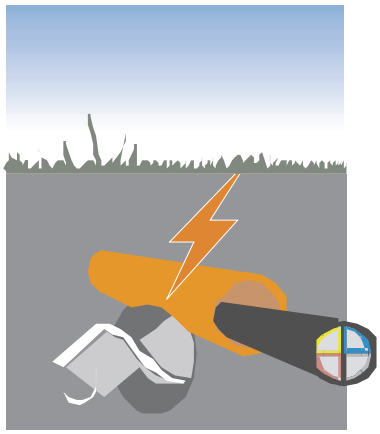

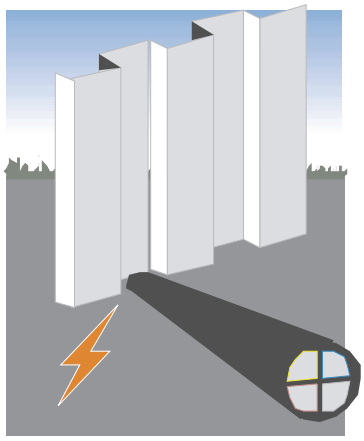

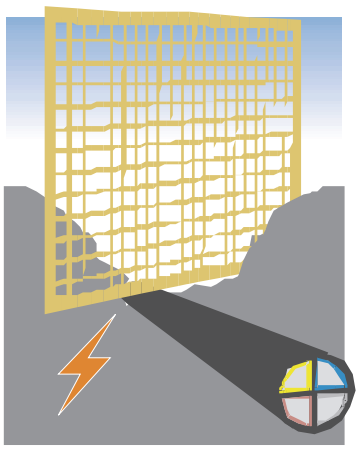

FOREWORD

The National Authority for Occupational Safety and Health (by virtue of Section 30 of the Safety, Health and Welfare at Work Act, 1989), following consultation with the statutory Advisory Committee on Construction Safety and with the consent of Mr Tony Killeen, Minister of State at the Department of Enterprise, Trade and Employment, has issued a Code of Practice entitled "Code of Practice for Avoiding Danger from Underground Services".

The Code of Practice provides practical guidance as to the observance of Regulations 3 to 6 and 21 of the Safety, Health and Welfare at Work (Construction) Regulations 2001 (S.I. No. 481 of 2001) which, inter alia, require that "adequate precautions be taken in any excavation, shaft, earthwork, underground works or tunnel to … avoid risk to persons at work arising from possible underground dangers such as underground cables or other distribution systems, the circulation of fluids or the presence of pockets of gas, by undertaking appropriate investigations to locate them before excavation begins …". The Code of Practice also provides practical guidance as to the observance of Section 8 of the Safety, Health and Welfare at Work Act 1989 in respect of relevant excavation work.

The aim of the Code of Practice is to improve the level of safety with which excavation work is carried out. In particular, it aims to reduce the incidence of damage to underground services, and in doing so to minimise risk to personnel who are involved in carrying out this work.

This Code of Practice comes into effect on 15 February 2005. Notice of the issue of this Code of Practice was published in the Iris Oifigiuil of 14 January 2005.

As regards the use of Codes of Practice in criminal proceedings, section 31 of the Safety, Health and Welfare at Work Act, 1989, provides as follows -

"31. - (1) A failure on the part of any person to observe any provision of a code of practice shall not of itself render him liable to any civil or criminal proceedings; but where in any criminal proceedings, a party is alleged to have committed an offence by reason of a contravention of any requirement or prohibition imposed by or under any of the relevant statutory provisions being a provision for which there was a code of practice at the time of the alleged contravention, subsection (2) shall have effect with respect to that code in relation to those proceedings.

(2) Any provision of the code of practice which appears to the court to give practical guidance as to the observance of the requirement or prohibition alleged to have been contravened shall be admissible in evidence; and if it is proved that any act or omission of the defendant alleged to constitute the contravention is a failure to observe such provision of the code, or if it is proved that any act or omission of the defendant is a compliance with such provision of the code, then such failure or compliance shall be admissible in evidence."

Martin O'Halloran
Assistant Chief Executive Officer & Secretary to the Board

Acknowledgements

This draft Code of Practice for Avoiding Danger from Underground Services was drawn up by an ad- hoc group reporting to the Advisory Committee on Construction Safety. The Code was subsequently approved by the Committee and officially adopted by the Board of the Health and Safety Authority.

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The Code is also partially based on certain elements of the Health & Safety Executive document, "Avoiding Danger from Underground Services" (HSG 47).

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1.0 Introduction

1.1 Background

This Code of Practice is the result of a joint initiative between the Health and Safety Authority, Construction Industry Federation, Irish Congress of Trade Unions, key utilities companies/service providers and local authorities that are involved in the provision and maintenance of vital underground services such as electricity, gas and water.

The aim of the Code of Practice is to improve the level of safety with which excavation work is carried out. In particular, it aims to reduce the incidence of damage to underground services, and in doing so to minimise risk to personnel who are involved in carrying out this work.

The Code was drafted in consultation with the organisations that are represented on the Health and Safety Authority Advisory Committee on Construction Safety.

1.2 Status of the Code of Practice

This Code of Practice is issued by the National Authority for Occupational Safety and Health under Section 30 of the Safety, Health and Welfare at Work Act, 1989 and with the consent of the Minister for Enterprise, Trade and Employment.

The Code is intended to provide practical guidance to utility companies, clients, designers, planners, project supervisors (both design and construction stages), safety representatives and any personnel who are involved in carrying out work where personnel are at risk from underground services.

A failure to observe any part of this Code will not itself render a person liable to civil or criminal proceedings. However, where the Code gives practical guidance on the observance of any of the relevant statutory provisions, compliance or non-compliance with those provisions may be admissible as evidence in criminal proceedings.

1.3 Scope of the Code of Practice

This Code of Practice gives recommendations and practical guidance on how to carry out excavation work safely in the vicinity of underground services. In this context "excavation" means any work that involves penetrating the ground at or below surface level.

Excavation carried out in the vicinity of underground services includes work associated with a new or existing building, which may involve the risk of damaging underground services. It encompasses all excavation work carried out on roadways, streets, footpaths and other open areas where there is a likelihood of buried underground services.

The Code also contains guidance on how to prevent future damage to services that are currently being installed.

2.0 General

2.1 Introduction

If they are damaged, electrical cables, gas pipes, water pipes and sewers may pose a direct danger to personnel who are working on the site. Damaged telecommunications cables may also be hazardous, although direct risk of personal injury is rare.

2.2 Electricity cables

Injuries that result from damage to live electricity cables are usually caused by the explosive effects of arcing current and by any associated fire or flames that 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 severely enough to cause internal contact between the sheathing and one or more of the conductors.

Typically, this causes severe and potentially fatal burns to the hands, face and body. Some high voltage electricity cables (e.g. 38kV and higher voltage) are filled with oil and, if damaged, the oil may auto-ignite and create an explosion or fire. Direct electric shock is rare but not impossible.

Incidents may also arise from cables that have been damaged, but have not been reported to the relevant service provider, and therefore have not been repaired. In such circumstances nearby services such as plastic gas pipes may be at risk from damaged live electricity cables, which could create explosions or increase fire risk.

2.3 Gas pipes

Damage to gas pipes can cause leaks which may lead to fires or explosions. There are two types:

(i) Damage that causes an immediate leak following a pipe rupture.

(ii) Damage that causes a leak some time after the event. For example, damage to a pipe wrapping may occur while work is being carried out and this damage may eventually lead to corrosion. Damage may also occur after the work has been carried out. For example, poor reinstatement may leave a pipe inadequately supported or subjected to unequal forces.

In the case of the former type of damage, those most likely to be at risk are personnel who are carrying out the work and others in the immediate vicinity. In the case of the latter type of damage, those most likely to be at risk are members of the public.

2.4 Water pipes and sewers

While damaged water pipes are less likely to cause an injury, a jet of water emanating from a high-pressure main could injure people or damage adjacent underground services. In addition, a water leak from an underground pipe could wash away subsoil, thereby reducing support for adjacent services, roads and structures. Additional dangers include the risk of flooding trenches or low-lying areas such as nearby basements.

Sewers are generally gravity fed, but some sewage is pumped at pressure. While the main risk to people associated with damage to sewers is the possibility of contamination, these pipes may also emit gases such as methane: at certain concentrations methane may be flammable.

2.5 Telecommunications cables

Although damage to telecommunications cables may be very expensive, there is normally no direct risk of personal injury.

2.6 Accumulation of gases

Flammable and toxic gases may escape into cable-carrying ducts, particularly if ducts have been damaged. Such gases may accumulate in chambers and manholes and may pose a risk to personnel who are carrying out work in these areas.

3.0 Role of the client

3.1 Introduction

A "client" is defined as a person or organisation on whose behalf a construction project is carried out. Under the Safety, Health and Welfare at Work (Construction) Regulations, the client must appoint a competent project supervisor design stage (PSDS) and a competent project supervisor construction stage (PSCS) for every construction project.

3.2 Information from clients

Clients or their agents have a duty to pass on any relevant information relating to underground services that may be in their possession to the PSDS or the PSCS. This information should be as up to date as possible. The client should also make available a copy of any safety file that is relevant to the construction work that is about to be undertaken.

3.3 Other duties

In accordance with Section 8 of the1989 Safety Health and Welfare at Work Act, it is the duty of each person (or company) who has control to any extent of any place of work, or any part of a place of work, to take such measures as are reasonable for them to take, to ensure so far as is reasonably practicable that the place of work is safe and without risk to health. In certain cases, this provision may be applicable to clients who commission projects that will involve carrying out excavation work near underground services.

4.0 The role of the project supervisor appointed for the design stage (PSDS) and designers

4.1 Definition of designer

The term "design" covers the preparation of drawings, design details, specifications and bills of quantities. A "designer" is defined as any person who is involved in such work.

4.2 The project supervisor design stage

All designers' work should be co-ordinated by a project supervisor for the design stage (PSDS). The PSDS has a duty to prepare and provide to the project supervisor for the construction stage (PSCS) a preliminary safety and health plan if the project is expected to last more than 30 days/500 person days, or if it contains a "particular risk", as defined in the Safety, Health and Welfare at Work (Construction) Regulations. One such "particular risk" is working near high-voltage power lines: this includes both overhead lines and underground cables.

The preliminary safety and health plan must contain an overall description of the project, its proposed timescale, and appropriate information relating to other work on site. It must also specify any work related to the project that will involve "particular risks".

Unforeseen circumstances may arise during the execution of the project, which may result in a design change. This may in turn have safety, health and welfare implications. The PSDS has a duty to direct the designers in relation to the safety, health and welfare implications of any change in the original design.

4.3 Use of plans during design

Where possible, the designers should obtain up-to-date maps and records of all potentially hazardous underground services in order to allow them consider, at the design stage, the risks posed by those services. Plans and maps should be made available to prospective contractors at tender stage or contract negotiation stage. Before beginning any work on a site, the contractor should be satisfied that the drawings supplied contain the most up-to-date information available for the area in which the works are to be carried out.

4.4 Underground services and building work

4.4.1 Relocating underground services some distance away from the proposed construction site may provide a reasonably practicable means of avoiding the risk of causing damage to these services. Any requests for the relocation of services should allow for sufficient time for the relevant utilities' providers to evaluate such proposals and carry out their work.

Buildings and other permanent structures should not be erected over underground services because this may create additional risks for construction workers and could

prevent future access to those services. If it is not possible to avoid erecting a structure over an underground service, arrangements should be made with the relevant utility provider to relocate the service if this is practicable.

4.4.2 Other options to resiting the services may include:

- repositioning structures or parts of structures to ensure that contact with underground services is avoided while the work is being carried out
- arranging for the supply contained within the underground services to be disconnected during the work.

If neither of these options is possible, then choosing methods to avoid contact, such as using ground beams to protect the service(s), may present a reasonably practicable option.

4.4.3 Designers should take into account any ancillary work that may be required including the erection of perimeter fencing and walls, or the construction of roadways. Early identification and planning are essential if risks are to be controlled.

4.4.4 Where new services such as electrical or gas supplies are being installed, it may be possible to reduce risks by not installing or commissioning these services until other ground works and installation works have been completed.

4.5 Underground services in paths and roadways

4.5.1 The options facing designers who are planning a new service in a roadway may be more limited. In order to select a route that avoids contact with existing services, it is important to have access to the most up-to-date information about those services. One option is to choose a route that has a low density of underground services. For example, a cable television duct might be routed at the side of a road, if that site has a reduced cable density. Designers of gas pipelines should also be aware of the guidance contained in IS328: 2000 Code of Practice for Gas Transmission Pipelines; IS265 Installation of Gas Service Pipes, and IS329 Code of Practice for Gas Distribution Mains.

4.5.2 Having reduced the risks to a level as low as is reasonably practicable by design, information should be provided by the designer(s) about the risks which remain. In most cases the best way of informing those physically excavating in the vicinity of underground services is by providing the information on drawings, ensuring that the information given is the best available.

5.0 The role of the project supervisor construction stage, contractor and utility/services provider

5.1 Project supervisor construction stage (PSCS)

The role of a project supervisor construction stage (PSCS) is to manage the project from a health and safety perspective. The PSCS must also develop the safety and health plan, which should outline how the management of the safety, health and welfare of on-site personnel is to be achieved. In addition, the PSCS must facilitate safe access to the site and co-ordinate the overall implementation of safe working procedures.

On completion of the project, a safety file must be handed over to the client. This file must contain relevant health and safety information that should be taken into account during any subsequent construction work on the site.

5.2 The contractor

All contractors must carry out a site-specific risk assessment. They should also ensure that their employees have adequate training and that any plant or machinery is, so far as is reasonably practicable, safe and does not pose a risk to health. They should also put in place measures to ensure that the health and safety of personnel who are employed by them are not adversely affected by work being carried out by the contractor.

Sections 6 to 13 of this document set out practical measures by which the safety, health and welfare of employees and non-employees may be protected while excavation work is being carried out in the vicinity of underground services.

5.3 Utilities

Utility/service providers such as local authorities, Bord Gáis and the ESB own most of the underground services, which, if damaged during excavation work, may pose a danger to contractor personnel. For that reason, utility/service providers should ensure that their records and maps are maintained as accurately as possible, and they should make these records readily available to designers and contractors, as appropriate. (See see Section 7.3).

In circumstances where a utility company is asked to provide permanent services for a building development, that company will be acting in the role of contractor. Therefore, while it is on site, it will be required to comply with any directives given by the PSCS. However, in circumstances where the provision of services is physically separated and demarcated from the site, then the utility company may assume the role of client for the purposes of the Safety, Health and Welfare at Work (Construction) Regulations.

6.0 Safe System of Work

6.1 Introduction

Underground utilities networks are a common feature in both rural and urban areas, and their presence should be assumed until proved otherwise.

The guidance given in this Code aims to minimise the possibility of risk to personnel who are involved in work that exposes them to contact with underground networks. It sets out a safe system of work that is based on obtaining as much information as possible about buried services before excavation work begins, and using that information to ensure that the work is carried out safely.

6.2 Basic elements

In the context of this Code, a safe system of work is defined as having three basic elements:

(i) Plans

Plans or other suitable information about all buried services in the area should be obtained before excavation work begins (see Section 4 on "The Role of the Designer" and Section 7.4 on "Use and Limitations of Plans"). This material should be passed on as early as reasonably practicable by the designer through the project supervisors to the contractor who is tendering for, or is negotiating the carrying out of, the works.

Plans that were used at the design stage and at the tendering stage may have gone out of date by the time excavation work begins. Therefore, before beginning any such work, the contractor should check that the plans supplied are the most up to date available.

Account should also be taken of possible indications of the existence of underground services such as the presence of houses or other buildings, lamp posts, illuminated traffic signs, pit covers, evidence of reinstated trenches and so on. However, the absence of such indications does not necessarily indicate that underground services do not exist.

(ii) 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 metallic underground services in or near the proposed work area. It should be noted however that these devices do not detect plastic pipes. (See see Section 8).

(iii) Safe digging practices

Excavation work should be carried out carefully, and should follow recognised safe digging practices. (See see Section 9).

These key elements – plans, locators and safe digging – complement each other, and all three should be used when working near buried services. Using one element alone may not be enough.

6.3 Employees

Employees should receive adequate instruction and training in the above procedures (see Section 14 on Training). A suggested job aid for workers' information is set out in Appendix (iv). It is particularly important that anyone who is using a locator should have received thorough training in the use and limitations of that particular type or model of device. Most manufacturers will provide such training, and employers should ensure that this is adequate for their employees' needs.

6.4 Procedures

The organisation and arrangements necessary for avoiding danger from exposure to underground services should form part of, employers' statutory safety statements. Written site-specific risk assessments of the work being undertaken should also be carried out.

7.0 Use of plans in the preparation of projects

7.1 Introduction

Up-to-date plans of all potentially hazardous underground services in the area should be obtained before excavation work begins. Where possible, providers of all relevant underground services should be consulted. It should be noted that, for certain types of utilities, there may be more than one service provider in a particular catchment area. For example, while most electricity cables under roads and other public areas are owned by the ESB, many electricity cables are the property of local authorities and are used for providing services such as public lighting, traffic lights and so on.

7.2 Emergency works

In the case of emergency* works it may not be possible to obtain all requisite up-to-date plans prior to beginning excavation work. In such situations, all other aspects of safe digging practice should be complied with (see Section 9), and the work should be carried out in the same manner as if there were underground services on the site.

7.3 Availability of plans from service providers

7.3.1 Utility or service providers should make available either up-to-date, readable plans that show the recorded line and depth (where known) of all underground services in the proposed work area, or they should provide other suitable information that achieves the same objective. The inclusion of a symbol key will generally be necessary to help the recipient understand the plans.

7.3.2 Utility or service providers should do everything that is reasonably practicable to ensure that such information is made available to enquirers. They are likely to receive many routine applications for information, and they should consider how best to make this information available at short notice. In cases where utility or service providers have reservations about releasing copies of plans, for commercial/security reasons, they should offer an alternative method of co-operation. For example, send a representative to the site to communicate the requisite information to designated contractor personnel only.

7.4 Use and limitation of plans

Plans vary in scale, content and style, and adequate instruction and training in how to read and interpret them should be given to anyone who needs to use them.

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* *If the question arises in criminal or civil proceedings as to whether or not works were emergency works, it is for the person alleging that they were to prove that this was the case. Clients and contractors should not use ' "emergency work' work" as an excuse to justify a failure to plan properly when starting work without plans or other suitable information about underground services in the area.*

Plans may give an indication of the location, configuration and number of underground services on a particular site. However, they are rarely drawn accurately to scale and, even if they claim to be accurate, they should not be relied upon in order to obtain accurate distance measurements. Errors may have been made during the drafting, or the reproduction process may have altered the scale of the plan, particularly if the original data was obtained from a microfiche slide or a digital map. Accuracy may be further limited because:

- the position of reference points (e.g. the kerb line) may have changed since the plans were prepared originally
- the regrading of a particular surface area may mean that the depths shown on the plan are no longer correct
- fixtures such as cables, may have been moved without the knowledge of the utility/service provider
- in many cases service connections are not marked
- services that appear as straight lines on a map may, in fact, be laid out in a snake-like formation; excessively long cables may have been laid in horizontal loops outside substations and switch rooms
- plans may show spare ducts; and
- the routes of older services in particular may not have been recorded and so the absence of records should never be taken as proof that the area in question is free of underground services.

8.0 Cable and pipe-locating devices

8.1 Position of services

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. This device should be used in conjunction with plans and other relevant information, (see Section 8.2(a)), as a guide to the possible location of services, and to help interpret the signal.

8.2 Types of locating devices

The main types of locator available may be classed as follows:

a) *Hum detectors* (e.g. a cable-locating device set on power mode) are receiving instruments that detect the magnetic field radiated by live electricity cables, ***which have a current flowing through them.*** However, these instruments will not detect service connection cables to unoccupied premises or street lighting cables during the daytime, as little or no current will be flowing through the cables at that time. They may also fail to detect some well-balanced high-voltage cables, where these cables generate little magnetic field. (It should be noted that the absence of current in a live cable does not in any way alter the risk of injury to a person if the cable is damaged).

b) *Radio frequency detectors* (e.g. a cable-locating device set on radio mode) are receiving instruments that 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, distance from the termination, and geographical orientation.

c) *Transmitter-receiver instruments:* With with these instruments a small portable transmitter or signal generator is connected to a cable or pipe, or placed very close to it, so that the signal is induced into it. The receiver then detects that signal. Usually, some part of the cable or pipe will need to have been located in advance of the operation in order to ensure that the transmitter is positioned correctly. Transmitter-receiver instruments generally require more skill to operate than other types of locators. They may, however, provide useful information in difficult situations where using locator equipment such as (a) and (b) above has not proved successful. In addition, they can provide a depth-measuring facility.

d) *Metal detectors:* Conventional conventional metal detectors will usually locate flat metal covers, joint boxes and so on, but may well miss round cables or pipes. They can be a useful tool for finding inspection points. These inspection points may themselves provide connection points for a transmitter for use of transmitter-receiver instruments.

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

8. 3 Locating the service

The degree of confidence with which buried services may be detected depends on a number of factors such as the characteristics of the devices being used; the type and depth of the service; the magnitude of the current carried by the cable; the effects of other cables and metal pipes close by; 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 cables or pipes are sited one above the other, it may not detect the lower one. For that reason, **frequent and repeated use of the locator should be made during the course of the work**.

With the possible exception of ground-probing radar, locators will not detect plastic pipes or other non-metallic ducts and services unless:

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 most likely type of non-metallic pipe to be encountered, and some of these pipes may have been laid with metallic tracer wires.

b) a small signal transmitter is inserted into and then pushed along the pipe. This is a sophisticated technique and is not likely to be appropriate for many sites.

Locating devices should always be used in accordance with the manufacturers' instructions. They should be checked regularly 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 should be erased after excavation as far as possible.

On grassed or unsurfaced areas, wooden pegs should be used. Steel pins, spikes or long pegs, which could damage services laid at shallow depth, should not be used.

9.0 Safe digging practice

9.1 Excavating

Once plans and a locator device have been used to determine the position of underground services, excavation may proceed. This work should be carried out carefully, following recognised safe digging practices. Trial holes should be dug using hand tools to confirm the position of any buried services. Special care should be taken when digging above or close to the assumed lines of any such services. **Hand-held power tools are the main source of danger to personnel, and they should not be used too close to underground services.** (See Appendices (i) and (ii) for advice on appropriate safety margins for electricity and gas respectively).

Hand tools, incorrectly used, are a common cause of accidents. However, if they are used carefully, and if the approximate position of services has been determined through the use of plans and locators, these tools may provide a satisfactory method for exposing underground services. 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 may 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. Rather, they should be eased in with gentle foot pressure;

(b) Picks, pins or forks may be used with care to free lumps of stone and other materials, and to break up hard layers; and

(c) Picks should not be used in soft clay or other soft soils in areas close to buried services.

Particular care should be taken in cases where gas leak search techniques such as barholing are used. Refer to Bord Gáis Éireann guidance material for advice.

9.2 Damaged services

If an underground service suffers damage, no matter how slight, the utility or service provider should be informed immediately. In the case of electricity cables, gas pipes or high-pressure water mains, arrangements should be made to keep personnel well clear of the area until it has been repaired or otherwise made safe by the utility or service provider.

9.3 Identification of services

Failure to identify underground services correctly could cause an accident. Correct identification may prove difficult as the utility or service providers may have used a wide variety of materials and colours over a number of years. It is important to remember that colours may appear differently under poor or artificial lighting. In addition, ducts may well contain any one of a number of services, irrespective of the type or colour of the duct. Some services are very similar in appearance, and the following approaches should be adopted until such time as as itstheir identity has been positively confirmed:

(a) The housing for some water pipes, electricity cables and telecommunications cables may be made from black plastic. If a black plastic-covered service is encountered, **it should be assumed to be a live electricity cable until proved otherwise.**

(b) Iron and steel water pipes may look very similar to gas pipes. Therefore, if any iron or steel pipe is uncovered, it should be handled as if it were a gas pipe.

(c) Some services run in ducts, which may make these services difficult to identify. Where red ducts are uncovered, the services inside those ducts are likely to be electricity cables of modern installation, and they should be treated as such. Where yellow ducts are uncovered, they are likely to be gas pipes and should be treated as such. Black and orange ducts have been used as standard colours for electricity cables in the past, and they should be handled as if they contained electricity cables.

(d) Electricity cables may also be installed in concrete pipes, steel pipes and in plastic ducts in a range of colours. **Where there is any doubt about the identity of an exposed service, it should be treated as if it were an electricity cable or gas pipe until proved otherwise.**

Ducts for electrical cables (where the cable voltage exceeds 125V) should be coloured red in accordance with Appendix (i)

All cables should be assumed to be live until disconnected and proved safe. Contractors should either obtain written confirmation of disconnection from the service provider before removing a redundant service or they should arrange for the service provider to remove the service.

9.4 Support to exposed services

Services uncovered in an excavation may need to be supported and should never be used as handholds or footholds by personnel when climbing out of an excavation.

9.5 Back-filling

Back-filling of any excavation should be carried out carefully. Where possible, any warning tiles, bricks, tapes and so on. that are lying above the services should be replaced in their original position unless an expert advisor confirms that the original position was incorrect. If the original position turns out to have been incorrect, then the warning tiles and other materials should be placed above the services to which they refer.

Warning tape should not be used for any other purpose such as guarding an excavation trench). Neither should the tape be left in the excavation area when it is back-filled.

Fill material that contains items such as large pieces of rock and hardcore should not be used as this could cause damage to the services.

For specific advice on back-filling in the vicinity of gas pipes (i.e. where long-term damage is a particular hazard) see Appendix (ii). Alternatively, utility providers may provide direction and advice on how to back-fill trenches in which their services have been exposed.

9.6 Burial of existing services

If underground services have been found to be too shallow, or if the plans or other information have proved to be inaccurate, the relevant utility or services provider should be informed – preferably before the excavation is back-filled. The utility or service provider should then amend their records accordingly.

9.7 Protection against burns

Burns are the main injuries that result from damage to live electrical cables, or from fire or explosion following a gas leak. In many cases a burn will be more severe if the injured person is working bare—chested.

While the wearing of ordinary work clothing may greatly reduce the severity of a burn, the wearing of protective clothing may be a more effective measure. However, clothing made from man-made fibres such as nylon may melt and adhere to the skin, thereby increasing the severity of burns. The wearing of protective clothing should never be used as a substitute for a safe system of work.

(For further advice on the types of clothing that should be worn when working near electricity cables see Appendix (i)).

9.8 Insulated digging tools

Where excavation work is being carried out near live cables it will generally be necessary to use insulated hand tools. Generally, tools such as shovels, spades or picks should have insulated fibreglass or wooden handles. Fibreglass crowbars are also available and these should be used where feasible. If this is not feasible, then the crowbars should be fitted with insulated handles.

10.0 Safe systems of work for trenchless methods

Increasingly, trenchless methods are being used for the laying or renovation of underground pipes and cables, particularly in cases where it is necessary to avoid disturbing surface areas. The most widely used techniques are impact-moling, pipe-bursting and auger-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 work too close to other services as displaced soil may escape into nearby pipes or ducts.

Plans, locators and trial holes should be used to determine the position of existing services. The path of the equipment to be used should then be calculated accordingly. In order to avoid danger and allow sufficient clearance for the maintenance of existing services, the general guideline is that the minimum clearance between adjacent services should be either 250mm or one and a half times the diameter of the pipe being laid, whichever is the greater. For electricity cables, clearances for maintenance work should be approximately 300mm.

In certain circumstances, clearances may need to be varied. Therefore, contractors should take into account factors such 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. In addition, the requirements of nearby utility/service providers may need to be taken into account.

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. Where trenchless methods are being used, all equipment should be earthed at all times. As an additional precaution, an equipotential mat may could be used in case the equipment strikes a power cable and this causes it to become live.

11.0 New housing developments

Underground services that are located within the confines of partly completed new housing developments are especially prone to damage from the numerous site operations that may need to be carried out.

The construction of a single trench may help to control the position and separation of underground services. Where services are laid on a partly developed site, special arrangements may be required for their temporary protection at vehicle/plant crossing points.

Close liaison should be maintained between the developers, their contractors, and the utility or service providers. A marked-up plan of the estate, showing the up-to-date position of underground services (including any variations from planned routes) should be kept on site.

12.0 Installation of new services near existing services

New underground services often have to be laid in ground that contains pre-existing services. Where it is reasonably practicable to do so, the utility/service provider that is planning the new installation should aim to position it in such a way that it is separated from all existing underground services by an adequate distance. Guidance on the requisite distances to be maintained may be found in the UK publication *National Joint Utilities Group (NJUG) Publication No. 7*. Every effort should be made to comply with this standard (unless otherwise noted in this code), or other equivalent standards of good practice for new installations, in order to minimise risk to personnel now or at some future date.

In circumstances where it is not possible to comply with the recommended standard, because of underground services congestion or some other factor, as great a separation as is reasonably practicable should be maintained.

Where the installation of a new service is likely to obstruct access to an existing service for more than a few metres, then all reasonably practicable measures should be used to avoid this situation. In particular, the practice of laying multiple ducts directly above other services should be avoided.

Where the utility provider that is laying the new underground service has had to reduce the separation distance, they should inform every other utility provider whose service has been affected. This will enable them to amend their records for future reference.

13.0 Demolition sites

Special difficulties may arise in the case of service terminations in a derelict property or on a demolition site.

Contractors who plan to engage in demolition work have a duty to give adequate notice to the relevant gas, electricity and water authorities of their intention to carry out this work. Demolition should not begin until the relevant authorities have confirmed in writing that the supply has been disconnected, or some other appropriate safeguarding action has been taken.
As noted in Section 4.3, there is an onus on the PSDS who is co-ordinating the design team to identify hazards associated with the existing environment including known hazardous underground services.

Underground services on industrial or commercial sites may be the property of the site occupier. A contractor who is planning to demolish buildings or plant on such a site should contact the site occupier or the site owner to ensure that all relevant services are isolated before demolition work begins.

Even where supplies have been disconnected, contractors should be aware that:

(a) Services that run through a site may not be providing a service to that site

(b) Bottle-ended or pot-ended cables must be treated as live unless confirmed otherwise.

(c) Some services may not have been recorded on the original plans and, consequently, may not have been identified or disconnected.

14.0 Training

14.1 Introduction

Digging close to underground services is potentially dangerous. Both the workers and the supervisors who are involved in this activity need an appropriate level of knowledge, skills and experience in order to ensure that the work is carried out safely. Anyone who does not possess these attributes should work under the close supervision of someone who does have the requisite experience and competencies.

14.2 Training for supervisors and operatives

In accordance with the Safety, Health and Welfare at Work (Construction) Regulations, operatives must satisfactorily complete the one-day Safe Pass training programme. However, this is an introductory course in construction safety and does not in itself provide sufficient training in relation to the hazards and risks involved in digging close to underground services.

Personnel who are **routinely*** involved in either the supervision or carrying out of excavations in the vicinity of hazardous underground services should be trained in the following areas:

a) Planning of the work
b) Legislation
c) Risk assessment
d) Liaison with utility providers
e) Use of plans and drawings from the various utility providers
f) Identification of services
g) Cable and pipe-locating devices
h) Appropriate use of these devices
i) Safe digging
j) Personal protective equipment.

The FÁS Roadworker Training Programme incorporates a module that deals specifically with these skills. This course or an equivalent course should be considered for those exposed to risks from underground services or managing those exposed to these risks as outlined above.-

Formal refresher training will be required periodically depending on the work being carried out by personnel.

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* *These include workers who manually work on excavations in streets, utility/or service provider employees who manually work on excavations, and those directly supervising these workers. Excavator drivers may be excluded if they have received sufficient relevant training on an excavator driving course. However, if they are involved in excavation outside the excavator, they should receive the stipulated training.*

Employees should not refuse reasonable offers of training; they should cooperate with their employers regarding training, and they should make relevant documentation demonstrating receipt of training available for inspection as appropriate.

14.3 Site based direct managers/supervisors

Those involved in direct management and supervision of site-based work require relevant competencies to deliver safety standards on site. They will need health and safety training in order to:

- assess and prioritise the risks on a particular project;
- design safe systems of work that are appropriate to specific site conditions;
- prepare clear, simple safety method statements that can be used and understood by site workers;
- check that appropriate personal protective clothing and equipment has been provided and is being used correctly. -

14.4 Role of the project supervisor construction stage in training

As part of their duty to manage site safety, the PSCS must have a system in place for checking that on-site operatives have been appropriately trained - – even if those operatives are not employees of the PSCS.

15.0 Notes on Appendices

Appendices (i) to (iii) give advice on matters relating to each of the four main types of underground services (gas, electricity, sewerage and water). This is additional information, and should be read and used in conjunction with the advice contained in the main text.

Appendix (iv) gives a suggested job aid for workers on a safe system of work for digging.

APPENDICES

Appendix (i): **Electricity cables**

Appendix (ii): **Gas pipes**

Appendix (iii): **Water pipes and sewers**

Appendix (iv): **Suggested job aid for workers on a safe system of work for digging**

Appendix (i): Electricity cables

Plans

A1.1 The electricity service providers should be consulted wherever possible, and all relevant plans obtained. (**Note**: While most electricity cables are owned by the ESB, many underground cables are the property of local authorities and are used for the provision of services such as public lighting, traffic lights and so on. Other underground cables may be the property of public bodies or private companies).

A1.2 The representation of underground cables on plans may vary depending on the density of the underground networks (i.e. the number of cables running in close proximity), the scale of the plans, and local historical recording conventions. Advice for interpretation should be sought from the issuing office. It should be noted that low/medium voltage cables and high-voltage cables may be shown on separate plans.

Cable-locating devices

A1.3 While hum detectors (e.g. cable-locating devices set on power mode) are the easiest devices to use, they do not respond to unloaded or direct current cables. Furthermore, they may fail to detect lightly loaded low-voltage cables (such as those used for street lighting) and well-balanced high-voltage cables. A locator with a radio frequency detection mode may detect these cables, and therefore should be used for additional back-up checks.

A1.4 Even where a locating device does not give a positive reading, there may still be cables present, and these may still be live.

A1.5 If a cable that is recorded on a 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

A1.6 In the vast majority of cases there will be no permanent surface markers or other visible signs to indicate 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 that might indicate their presence.

A1.7 Underground cables are normally laid in trenches between 400mm and 1m deep. However, depths should never be assumed. Cables are often found just below the surface. As a result therefore, even shallow excavations may present a source of danger. This factor should always be borne in mind, particularly if the ground has been disturbed or if there are cellars or other structures such as bridges in the area, which may have prevented cables being laid at standard depths.

A1.8 Cables may have been laid in any of a number of different ways – directly in the ground with a bed or surround of fine soil or sand; in earthenware or concrete pipes; in pitch-filled cast iron formers, or in plastic pipes or ducts. Occasionally they may be encased in steel pipes, or a covering of tiles, bricks, slabs, timber boards or coloured plastic marker tape may be laid above them. However, such coverings may have been disturbed and moved subsequently, and therefore should not be relied upon to give an accurate indication of cable position. These factors further emphasise the importance of using safe digging practice.

A1.9 During digging work, a careful watch should be kept for evidence of cables, and repeat checks should be made with a locator to determine more precisely the position of any cable. It should be noted that a cable should be considered positively located only after it has been safely exposed. Even then, digging should proceed with care, as there may be other cables, particularly high-voltage cables, nearby or lower down.

A1.10 Occasionally, cables are terminated in the ground by means of a seal, or some other form of external mechanical protection. These 'pot-ended' or 'bottle-ended' cables should always be treated as live and should not be assumed to be abandoned or disused. They may be difficult to detect with locators even when live.

A1.11 When joints on electricity cables are encountered, they should be treated with extreme care. The joints may be enclosed in cast iron or earthenware casings, or in plastic casings. They need proper support and should never be disturbed, except following consultation and agreement with the utility or service provider.

A1.12 The use of 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 hard surface. Where power tools have been used to break away the surface from the indicated line of the cable, it should then be positively located by careful hand digging under the hard surface. The material under the hard surface should be removed gradually until the cable is exposed. If the cable is not exposed, then it must be assumed to be embedded in the hard 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 it may be difficult to confirm 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 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 Section 9.

A1.13 Excavating close to electricity cables buried in concrete is dangerous. For this reason alone electricity cables should not be buried in concrete, and the utility or service providers should ensure that their own employees and contractors are aware that this practice is unacceptable.

A1.14 Using mechanical means to break up concrete can cause damage to cables. If the cable is live, anyone present is likely to be injured.

A1.15 Alternative routes should be carefully considered as a means of avoiding cables that are buried in concrete.

A1.16 Where it is necessary to break away or disturb the concrete in which a cable is embedded, either the utility or service provider should be asked to disconnect it from supply, or an alternative safe method of excavation should be agreed with the utility or service provider before excavation work begins. It is important to note that the use of powered hand tools close to cables is likely to represent the greatest risk of injury.

A1.17 Where a buried cable has been disconnected from supply to allow for safe excavation, it is essential that liaison should be maintained between the parties involved to ensure that the work has been completed and that workmen have cleared the site before the cable is reconnected.

A1.18 Where mechanical excavators are being used in an area likely to be in the vicinity of underground cables, the work should be arranged in such a way as to ensure that damage to cables is avoided. In addition, all personnel should be kept well clear of the excavator bucket while digging work is going on.

Drivers should be instructed to remain in the cab if a cable is struck. If the driver has to leave the cab, he should jump clear of the machine rather than climb down: otherwise, he may be electrocuted. A designated person should be assigned to guard the excavator and ensure that no person enters the area or touches either the excavator or the cable until the utility or services provider has made the damaged cable safe.

A1.19 The most common injuries resulting from cable accidents are flash burns, splatter burns from molten metal or ignited oil, and electrical burns. If electrical cables are likely to be encountered during excavation work, employers should take into consideration in their risk assessments whether the work merits issuing personnel with either flame-retardant clothing, or clothing designed to protect against an electric arc. Advice on the suitability and performance of personal protective clothing should be sought from reputable companies that specialise in this area.

A1.20 Accidents sometimes occur after underground cables have been exposed. Cables should not be used as handholds or footholds by anyone climbing in and out of the trench. Where a cable that is exposed for more than one metre crosses a trench, support should be provided. If the exposed length is less than one metre, support should still be considered if joints have been exposed or if the cable appears otherwise vulnerable to damage. If advice or help is needed, the cable service provider should be contacted.

Suitable precautions should be taken to prevent damage from ongoing work in the excavation area (e.g. by use of physical means such as timber boards or sand bags). Cables that are lying at the bottom of an excavation area should be protected by nail-free wooden planks, troughing or some other suitable means, and care should be taken not to use materials or equipment that could damage or penetrate the cables' outer

sheath of the cables. Cables should not be moved aside unless the operation is supervised by the service provider. Precautions should be taken to prevent access to exposed cables by children or other unauthorised personnel.

A1.21 Hard or sharp materials such as pieces of rock, large stones, hard-core or surplus concrete, should not be tipped into open cable trenches. Advice on back-filling cable trenches should be obtained from the cable service provider. As a general rule, all exposed cables should be back-filled with a 75mm minimum surround of compacted sand. Disturbed tiles and bricks should be replaced, and new warning tape should be placed above the excavated area.

A1.22 Any damage to an electricity cable should be reported immediately to the cable service provider, and work should not be undertaken in the vicinity of a damaged cable until the service provider has investigated its condition. (Some cables may automatically 'trip out' when damaged, but these may be reconnected after the cable service provider has been notified of the damage).

A1.23 Recommended standards for new underground electricity cable installations on new developments and in existing roads and streets.

Buried electricity cables may be laid either directly in the ground or they may be installed in impact-resistant ducts or pipes. As a general guideline, new cables should be installed at depths of approximately 450mm in footpaths and driveways and at greater depths of approximately 600mm when installed in road carriageways or grassed areas.

However, local conditions may dictate that these depths vary, particularly where pipes and cables cross, or where underground structures or other obstructions are crossed. Depths may also vary at entrances to buildings, beside street furniture and at underground link disconnection boxes. Deviation from the recommended standards outlined above should only occur if local conditions make compliance impracticable. If cables are buried at shallower depths than those recommended, then this should be noted on the record drawings.

The clearance in all directions between underground electricity cables and other services should be approximately 300mm. With the exception of crossing points, services should not be laid above electricity cables. This is because, following installation, continuous access will be required for the repair of faults or the installation of new service connections. These connections are usually jointed live in the case of low-voltage mains cables.

While there is no agreed industry standard in Ireland governing the relative lateral positioning of services in footpaths, general guidance may be found in the UK publication *National Joint Utilities Group (NJUG) Publication No. 7*. Efforts should be made to comply with this standard, or other equivalent standards of good practice for new installations, in order to minimise the risks that arise from the installation of underground services.

A1.24 Colour marking and strength specification of ducts for underground electricity cables

a) All new underground ducts laid for the installation of electricity cables of 125V or greater must be **RED** and must carry the warning: **DANGER ELECTRICITY CABLES**. They must also conform to the deformation and impact resistance requirements and all other requirements as set out in the "Material Specification" in Section A1.25 below.

A1.25 MATERIAL SPECIFICATION FOR RED uPVC AND MDPE DUCTING FOR THE INSTALLATION OF UNDERGROUND ELECTRICITY CABLES

	MAINS CABLE DUCT	HOUSE SERVICE CABLE DUCT
Duct outside diameter (mean)	125.0mm – 125.4mm	50mm
Duct type	uPVC, 6m lengths; Spigot spigot and socket type	MDPE, 6m straight lengths or 50m coils
Duct rating	Normal duty per EN 50086 – 2 specification	750 N – EN50086 – 2
UPVC quality	100% virgin material	100% virgin material
Duct colour – outside	Red – BS Type 5252 04E53 – 04E56	Red as for 125mm Minimum 1mm thickness of colour
Duct deformation requirement	Must pass EN50086 – 2 <5% deformation requirement for 450N loading on 200mm sample	Must pass EN50086 – 2 <5% deformation for 750 N loading on 200mm sample
Impact resistance	Per 50086 – 2 12 samples; 5kg striker: 570mm fall height:>28 Joules – no crack in at least 9 samples	As for 125mm
Duct minimum wall thickness	The larger of the two criteria below;: (1) Wall thickness to pass 5% deformation /impact requirement above **and** (2) Minimum wall thickness of 3.8mm (required for cable pulling)	Duct wall thickness based on 750N loading test.
Duct end; spigot end	Spigot; : plain end bevelled to allow easy jointing of duct on site, minimum thickness of plain end to be 1.3mm, bevel length ≥ 5mm	Duct ends bevelled to allow jointing of duct on site.
Circumferential mark on plain pipe end for correct push-in distance	Circumferential mark required to indicate Correct push- in distance for duct jointing For for spigot and socket joints. Location: 105mm – 110mm to suit socket length below	Clear circumferential mark required to indicate correct push- in distance for duct jointing using standard 50mm couplers
Duct ovality including socket	2.00mm max	1.4mm max
Eccentricity of socket relative to duct	None allowed and no angle allowed between socket centre line and the duct longitudinal axis to avoid ripping of cable sheath during cable pulling	None
Duct inner surface	Smooth low friction surface completely free of ripples, sharp edges & protrusions. Friction coefficient <0.28	As for 125mm ducting Friction coefficient <0.28

DUCT MARKING		
Legend content:	"DANGER ELECTRICITY CABLES"	"DANGER ELECTRICITY CABLES"
Repetition rate/gap between legend	150mm max gap between adjoining Legends	150mm max gap between adjoining Legends
Colour of legend, size of lettering	Black 2 X 20mm height i.e. 2 lines of 20mm height @ 180° apart. NOTE; : 3 lines of 20mm height@120°	Black 2 X 8mm – 10mm height @ 180° apart
	6mm minimum lettering size	6mm minimum lettering size
Batch No/name of manufacturer AND date of manufacture	**one year** minimum required so as to provide 12-month storage period at builders providers premises	**one year** minimum required so as to provide 12-month storage period at builders providers premises
Red colour fastness	One one year outdoor weathering test required or suitable accelerated colourfastness test	
All bends for 125MM duct	All Angles: radius = 1.2m minimum for 22, 45 and 90° material as per pipe specification above. (3.8mm minimum)	
Bend ovality	2mm max (same as for pipe)	
Couplers for 50mm OD duct		Slip or rubber gasket type with no internal obstructions/sharp edges. A centring ridge is required that does not protrude.

Appendix (ii): Gas pipes

A2.1 GENERAL

Natural gas, which is highly flammable, is transported in a network of polyethylene and steel pipes at pressures ranging from 70 Bar to 20 mBar. Damage to a gas main may result in large volumes of gas escaping into the atmosphere in an uncontrolled manner. Even if there is no smell of gas, any damage to a gas pipe should be reported regardless of how minor the damage might appear to the naked eye. An immediate repair may prevent an accident at a later stage due to a stress failure at the location of the original minor damage.

Most underground gas pipes are the property of gas transmission or distribution companies. One notable exception to this is private 'metered' estates, which may have gas piped to users from a bulk liquefied petroleum gas (LPG) tank. In the case of the latter, the service provider should be able to supply the requisite information. Estates that comprise privately owned dwellings do not normally have a site owner or manager. In such circumstances information may be obtained from the LPG supplier whose name and telephone number (manned 24 hours) should be displayed in the bulk storage vessel compound. The risks associated with leaking LPG are even greater than those associated with leaking natural gas as it is heavier than air and does not disperse as readily. In addition, it can travel great distances below ground level before accumulating at low levels.

All personnel who are involved in carrying out work near underground gas plant should observe the specific requirements set out by gas utility companies, and should ensure that their staff or representatives may have access to the plant at all times. No unauthorised repairs to gas pipes should be made. If there is any doubt about the need to carry out repairs, the advice of the relevant gas company should be sought.

Natural gas pipeline infrastructure in Ireland may be categorised as follows:

Steel **Transmission** pipelines operating at internal pressures ranging from 7Bar to 85Bar. PE/steel **Distribution** pipework operating at internal pressures ranging from 20mBar to 4 Bar.

The following points are relevant to both transmission and distribution:.

The promoter of the new works should notify gas pipeline companies before any of the following activities are carried out in the vicinity of existing gas infrastructure. :

- **Excavation, which includes any site investigation work such as trial pits or boreholes**
- **Use of naked flame – welding or other hot works involving naked flame**
- **Use of explosives – before a decision is made to use explosives for blasting within 30m of any part of gas pipeline infrastructure (400m for transmission infrastructure), advice should be sought from the gas pipeline utility companies**
- **Piling – gas pipeline companies must be consulted before any piling is carried out within 15m of an existing gas pipeline**

Plans

On request, the local gas service provider will confirm approximate locations of gas pipes, usually in the form of plans. Early contact, preferably at the planning stage, is beneficial and will allow full discussion of proposals to ensure the safety of plant and operators. Plans do not normally show the position of service connections. Their existence should be assumed and it may be possible to estimate the probable line of the service connection pipe from the gas meter position, or from the point of entry to the premises. Where the presence of gas mains which operate at pressures of 4 Bar (60 psig) and above is indicated, the service provider should be further consulted further before work begins.

Pipe locators

Locator devices that use radio frequency detection or transmitter/receiver technology should be used to help locate metallic gas pipes before excavation. However, it should be noted that, increasingly, gas pipes are made of plastic and therefore cannot be traced by such devices. This factor further reinforces the importance of using plans and safe digging practices.

Safe digging practice and avoidance of long-term damage

The depth of cover from gas mains laid in a roadway is normally 750mm. For those laid in a footway it is 600 mm. The depth of cover for gas service connections is normally 450 mm in both roadways and footpaths. However, at entry points to buildings, the depth of cover for a service connection may be 375mm. It is important to note that these depths are merely a guide and pipes may be found at shallower levels. For example, pipes such as those passing over cellars or in the vicinity of bridge structures may have been laid at shallower levels, or the depth of cover may have been reduced after the pipe was installed because other work such as road alterations were being carried out in the area.

Gas pipes

Gas pipes are laid directly in the ground although in certain soils selective backfill may have been used as a bed and pipe surround. Ductile iron pipe will sometimes be found wrapped in loose fit polyethylene (plastic) sleeving as protection against corrosion. Polyethylene mains may be inserted into redundant cast iron or ductile iron gas mains. Marker tiles may be used above gas pipes, e.g. where they have been laid at a shallow depth in bridge structures or above cellars.

Polyethylene mains may have a coloured plastic marker tape above them. 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 pipe position.

Plastic gas pipes

Plastic gas pipes should be located by hand digging before mechanical excavation begins. It may also be necessary to use this method to locate metallic pipes if their position has not already been determined by a pipe-locating device. The use of hand digging is particularly important for service connection pipes, which will not be marked on plans. The recommended method is to dig a trial trench along the road near the kerb, or on the footpath, where the depth of the service connection pipes is likely to be at its shallowest. Once the position and depth of the pipes have been determined, work may proceed.

Gas pipes

Gas pipes may have projections such as valve housings, siphons and stand pipes and these will not be shown on the plans. In order to allow for these projections, mechanical excavators should not be used within 0.5m of a gas pipe. However, depending on pipeline pressure, the gas company may advise maintaining even greater safety distances.

Hand-held power tools

Hand-held power tools may damage buried gas pipes and they should be used with care until the exact position of an underground pipe has been determined.

Crossing points

In cases where heavy plant and other machinery may have to cross the line of a gas pipe during construction work, the number of crossing points should be kept to a minimum. These points should be clearly indicated, and crossings at other positions along the line of the pipe should be prevented. Where the pipe is not adequately protected by an existing road, crossing points should be suitably reinforced with sleepers, steel plates or a specially constructed reinforced concrete raft. The utility or service provider will advise on the type of reinforcement necessary.

Explosives

Explosives should not be used within 30m of a gas pipe, and piling or vertical boring should not be carried out within 15m of any gas pipe without prior consultation and agreement with the service provider. The service provider should be consulted before carrying out excavation work within 10m of any above-ground gas installation.

Welding

If welding or other hot work involving naked flames is to be carried out close to gas plant, and the presence of gas is suspected, the utility or service provider should be asked to carry out atmosphere checks before work begins. Even if the atmosphere is gas-free, care should be taken to ensure that no damage occurs. Particular care should be taken to avoid damage by heat, sparks or naked flames to plastic gas pipes or to the protective coatings on other gas pipes.

Building in and around gas pipes

No manhole, chamber or other structure should be built over, around or under a gas pipe, and no work should be carried out that results in a reduction of cover or protection over a pipe, without first consulting the utility or service provider.

Excavations near gas pipes

Where gas pipes cross, or are parallel and close to excavations, changes in back-fill may cause differential ground settlement and increased stress in the pipe. Where pipes are parallel and close to excavations, the degree of risk depends on the depth of the excavation, the distance of the pipe from the excavation and the type of soil. If an excavation is likely to affect support for a gas pipe, the service provider should be consulted. In some cases it may be necessary to divert the gas pipe before work begins.

Use of back-fill during excavation work

If a gas pipe is uncovered during excavation work, the back-fill should be adequately compacted, particularly beneath the pipe itself. This measure is designed to prevent any settlement that could subsequently damage the pipe. The back-fill should comprise fine material or sand, and should not contain stones, bricks, lumps of concrete etcand so on. It should be suitably compacted to give comparable support and protection to that provided before excavation. No power compaction should take place until a 200mm cover of selected fine-fill is in place.

Road construction work

If road construction work is being carried out close to the top of a gas pipe, the service provider should be asked to give directions on specific precautions to be taken.

Use of concrete or other hard material

Concrete or other hard material should never be placed or left under or near any gas pipe as this could cause pipe fracture at a later date. Concrete back-fill or slabbing should not be used within 300mm of a gas pipe.

Uncovering a gas pipe during excavation

If a gas pipe with a damaged wrapping is uncovered during excavation work, the service provider should be informed so that repairs may be carried out to prevent future corrosion and leakage.

Pipe restraints

Pipe restraints or thrust blocks close to gas mains should never be removed.

In the event of damage to a gas pipe/pipeline, work should cease immediately and the following precautionary measures should be taken:

1. Report all damage even if there is no smell of gas.
2. Shut down all working plant in the area near the damaged pipe.
3. Keep personnel away from the affected area.
4. Prevent all sources of ignition (e.g. smoking, naked flames etc. and so on)
5. Do not use mobile phones near the gas leak.
6. Do not try to repair the damage.
7. Contact the gas company emergency service (24 hours).
8. Assistance is to be given to gas company emergency crews as necessary, or as requested, to safeguard both personnel and property.

A2.2 Special considerations for transmission gas pipelines

A2.2.1 GENERAL

Transmission gas pipelines may be described as follows:

- Very high pressure
- Fully welded steel pipes
- Generally, size ranges from 150mm to 1metre diameter
- Pipelines usually have either a sacrificial (CHECK) or an impressed current cathodic protection system. In addition, the pipeline is coated in yellow and/or encased in black wrapping.
- Minimum depth of cover is 1.0m but cover may be less in some cases.

A2.2.2 LOCATING THE TRANSMISSION PIPELINE

Before any work is carried out in the vicinity of existing gas pipelines, the gas pipeline company representative should arrange for location and pegging out of the pipeline as well as for the supervision of the digging of any trial holes necessary to confirm the position of the pipe.

A2.2.3 Design considerations for installation of new services close to transmission gas pipelines

I. Orientation and location

Where a new service is to cross either above or below an existing gas pipeline, the normal minimum distance between the outside of the pipeline and the service to be installed should be 600mm.

In special circumstances this distance may be reduced at the discretion of the pipeline company engineer. At such crossings both the pipeline and the new service should be

suitably supported to prevent any future settlement and the back-fill should be packed and consolidated to the satisfaction of the pipeline company engineer (see Section **A2.2.5**2.5).

As a general rule, no new service should be laid parallel to an existing gas pipeline. However, in special circumstances (e.g. motorways) a new service may be laid parallel to an existing pipeline provided that there is adequate clearance (normally 600mm) between them, and provided that the service is not laid either directly above or below the existing gas pipeline.

2. Cathodic protection

Transmission gas pipelines are cathodically protected. Where a new service is to be laid and is to be similarly protected, the gas pipeline company is obliged to carry out interaction tests to determine whether its own system is adversely affected.

3. Pressure testing

Hydraulic testing should not take place within 8m of an existing gas pipeline unless precautions have been taken to mitigate the effects of a possible burst. These precautions may include the use of pre-installation tested pipe, sleeving, barriers, and so on, as directed by the pipeline company engineer.

A2.2.4 EXCAVATION

Where it is necessary to excavate below a transmission gas pipeline, the pipeline must during all stages of the operation be supported to the satisfaction of the engineer. On completion, permanent supports should, if necessary, be constructed to avoid future settlement.

Mechanical excavation by powered tools is not permitted within a distance of 3m, and the use of hand-held power-assisted tools should not be permitted within 1.5m of a transmission gas pipeline or associated equipment.

Consideration may be given to a relaxation of these limits provided that prior notice is given to the gas pipeline company of the excavating methods to be used and the safeguards to be employed.

To avoid damage during construction work, exposed gas pipelines must be protected by cladding, (e.g. timber), as directed by the pipeline company engineer.

A2.2.5 BACK-FILLING

Those responsible for the new works should give the gas pipeline company at least 48 hours notice of their intention to back-fill under, over or near an existing transmission pipeline. The gas pipeline company representative must be in attendance during all back-filling operations and advise on the suitability and degree of consolidation of back-fill material around the pipeline.

Any damage to the coating of the transmission gas pipeline, even if minor in extent, must be brought to the notice of the gas pipeline company representative so that necessary repairs may be carried out before back-filling is completed. Any minor damage caused to pipe coating and test leads that has been brought to the attention of the gas pipeline company must be repaired by that company.

A2.2.6 SPECIAL OPERATIONS

Use of explosives: Before a decision is made to use explosives for blasting within 400m of any part of gas pipeline infrastructure, advice must be sought from all relevant gas pipeline companies.

Piling: Gas pipeline companies must be consulted before any piling is carried out within 15m of an existing gas pipeline.

Appendix (iii): Water pipes and sewers

The appropriate records office should be contacted, and the location of all sewers, water mains, kiosks, meters and wiring/cable ducting should be determined before any excavation work begins.

The location of mains on drawings should be taken as approximate. In general, if there is a sewer or water main (diameter is >= 300mm) in the vicinity, then the appropriate service provider engineer should be contacted in order to co-ordinate the excavation work.

Mains runs must be marked out before excavation begins.

During excavation, in addition to the safe digging practice previously outlined in this document, the following precautions should be taken:

a) If a water main spans a road cutting or similar excavation, then the main must be adequately braced so that no movement takes place.

b) If a pipe anchor is exposed, then excavation must cease and the appropriate engineer must be contacted.

c) Fittings (ferrules, air valves and so on) should not be interfered with.

d) Excavation in vicinity of mains must be carried out by hand in order to avoid damage to the pipe.

If the pipe in question is a high-pressure trunk main, then the following additional precautions must be adhered to:

1. No personnel should be positioned inside the trench while the mechanical excavator is operating, in case a high-pressure break occurs.

2. Continuous inspections are essential in order to determine whether the next excavation level is clear.

3. If any leak is discovered, then the service provider must be contacted immediately and the area sealed off to keep it safe and to prevent members of the public from gaining access.

Appendix (iv) - Suggested job aid for workers on a safe system of work for digging

WORKER JOB AID

Safe System of Work for Digging

These Guidelines apply to all work which involves penetrating the ground at or below surface level.

When working near buried services USE

Maps
CAT
Safe Digging System
Company Policies & Procedures

All 4 complement each other

Always be aware that the depth of cover may be very shallow and that there may be no bricks, warning tape or other protection in place. Always assume that there will be more services than you can find.

BEFORE You Start Digging

- **Ensure you have appropriate Utility Plans** *Remember :* service connection cables & pipes from *the main to buildings or public lights may not be shown*

Look Out For

Manhole Covers
Valve Covers
Lamp Posts
Houses/Buildings
Meters, Coms. Network
Signs of Previous Digging

Services

- **Always use Cable Locator (CAT) to trace all services**
- **Mark the positions of the cables & pipes** *using waterproof crayon, chalk or paint*
- **Highlight & Assess the Hazards** and **ensure all relevant staff are aware of the hazards, especially** when electric cables and/or gas mains are in vicinity of work area.

IMPACT

- **Inspect Site Location. Look for indicators to services**
- **Mark the location of services on the surface before digging**
- **Plans and Maps should be available & used on site before digging**
- **Always assume that there will be more services than you can find**
- **CABLE LOCATOR should always be used (in Power & Radio modes) before starting work and throughout the course of the work**
- **Take Care. Where ever possible hand dig close to buried services. Observe 'SAFE DIGGING PRACTICE'**

WORK USING 'SAFE DIGGING PRACTICE'

1. Where ever possible **Hand Dig** near buried services
2. Take special **CARE** using picks, pins or crowbars
3. Wear **Gloves** & other appropriate **PPE** *(Personal Protective Equipment)*
4. Do not use hand held power tools within 0.5 metres of marked position of electricity cables unless the no. of services makes it impossible or surface obstructions reduce the space available.
5. Do not use hand held power tools directly over marked line of cable **UNLESS -**
   a) 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**
   b) Physical means have been used to prevent the tool striking it.
6. When the surface has been broken out use CAT again to re-confirm position of services. Frequent and repeated use should be made of CAT during the course of the work.
7. Before using a mechanical excavator in the vicinity of electricity cables, trial holes should first be excavated by careful hand digging. Confirm the depth of the cable(s) at the point of work. The excavator should not be operated within a radial distance of 300mm from the cable(s).
8. When using Mechanical Excavator in the vicinity of electricity cables keep everyone clear of bucket while it is digging
9. Where an electric cable is embedded in concrete, arrange for the cable to be SWITCHED OUT before breaking off concrete.
10. Do not use exposed electricity cables as a convenient step or hand hold.
11. Do not handle or attempt to alter the position of an exposed electricity cables (unless under the direction of approved ESB personnel). Extreme care should be taken where joints have been exposed.
12. If an electricity cable, gas pipe or high pressure water mains suffer any damage, however slight, the owner should be informed immediately and people should be kept well clear of the area until it has been made safe by the owner.
13. Backfill around services with sand and use appropriate utility warning marker tape. Do not build into manhole or other structure or encase in concrete.

NOTES

NOTES

Code of Practice for Avoiding Danger from Underground Services

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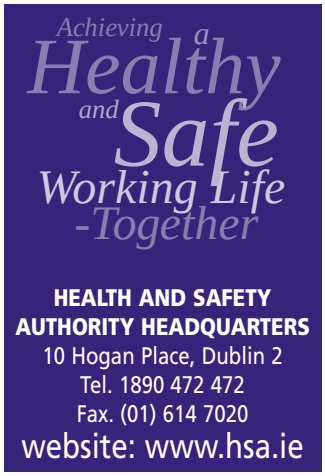

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