



Petroleum Development Oman L.L.C.

Excavation and Working Around live Pipelines (GU-501)




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ii Revision History

The following is a brief summary of the recent revisions to this document. Details of all revisions prior to these are held on file by the issuing department.

| Revision No. | Date | Author | Scope / Remarks |
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| Revision 3 | Aug 2015 | UEL | Minor changes – references to SP-1187 changed to GU-629; PDO Road cross software references deleted. |
| Revision 2 | Sept 2011 | UEL1 | Reviewed, updated and revised. Major updates includes the followings: 1) Update of all applicable references and standards throughout the document. |
| Revision 1 | Oct-05 | | Changed to GU and revised / new format. |
| Revision 0 | Aug-97 | | Original Issue ERD 38-11 |

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1 Introduction

1.1 Background

This guideline provides for the safe execution of work within the Right of Way of live pipelines and is intended to be used for work on or around lines which are in operation, operating at reduced pressure, or shut in but not evacuated. Limitations and minimum requirements are defined for site preparation, excavation methods, trench dimensions, pipe support, and backfill and area reinstatement.

Repairs, modifications or other work conducted directly on the live pipeline are outside the scope of this Guideline and are covered under separate Company or Project Specifications.

Typical activities involving work on or around operating pipelines are listed below. The list should not be considered exhaustive.

- Coating rehabilitation
- Sleeving installation, hot tapping and stoppling operations
- Repair and replacement of line pipe crossing of existing pipelines in the course of new construction
- Road and track maintenance, pipeline protection at wadis
- Third party projects involving crossings.

1.2 Purpose

The purpose of the guideline is to assist PDO and contract personnel when carrying out work on or around live pipelines. The guideline shall be used in conjunction with SP-1208 and any Job HSE Plans developed for the work.

1.3 Distribution / Target Audience

This guideline is intended for use by PDO pipeline, third parties and Contractor staff as a source of reference.

1.4 Structure of This Document

This guideline is structured to provide a clear reference to key requirements for safe excavation around live pipelines. Illustrations are used where appropriate to add clarity to description.

1.5 Definitions

1.5.1 General

For the purposes of this Procedure the following definitions shall be used:

| | |
|-----------------------|--|
| Shall | The word 'shall' is to be understood as mandatory |
| Should | The word 'should' is to be understood as strongly recommended. |
| May | The word 'may' is to be understood as indicating a possible course of action. |
| Accountability | State of being liable for certain actions to be taken and results achieved |
| Responsibility | The state of being required to undertake specific actions. The execution of a delegated task, activity or process. |
| The Company | Is Petroleum Development Oman LLC |

| | |
|---|---|
| The User | Is the Company, Consultant or Contractor designate who uses this document |
| The Corporate Functional Discipline Head | Is the person responsible for the discipline the standard belongs to (CFDH) |

1.5.2 Specific

The Right of Way (refer to Royal Decree 8/2011)

The existing oil and gas pipeline and that will be constructed in the future shall have a Right of Way of 25 meters on each side from the centre of the pipeline, and the Ministry in coordination with the competent authorities determine the Right of Way in urban areas with a distance that shall not be less than that. (This Royal decree cancels the first issued - 2/1999)

Verification Point

Defines a completed activity, at which the Contractor shall stop and seek Company approval before continuing on to a subsequent activity.

Topsoil

Is that material, whatever the composition, which is present from the natural ground surface to 10 cm below the ground surface. A windrow shall not be considered natural ground surface

Windrow

Is the pile of undifferentiated material placed along the longitudinal axis of the pipeline. It is approximately triangular in section and has a nominal height of 1.0 metres and a minimum base width of 1.5 metres

1.5.3 Abbreviations

The following abbreviations are used in this Procedure.

| | |
|------|---------------------------------|
| CIPS | Close Interval Potential Survey |
| CP | Cathodic Protection |
| DCVG | Direct Current Voltage Gradient |
| FOC | Fibre Optic Cable |
| FRP | Fibre Reinforced Plastic |
| GRP | Glass reinforced plastic |
| HSE | Health, Safety and Environment |
| PTW | Permit to Work |
| PVC | Polyvinyl Chloride |
| ROW | Right of Way |
| RTR | Reinforced Thermoplastic Resin |

1.6 Changes to the Document

Responsibility for the upkeep of the Document shall be with the CFDH Pipeline Support, the Owner. Changes to this document shall only be authorised and approved by the Owner.

Users of the Document who identify inaccuracy or ambiguity can notify the Custodian or his/her delegate and request changes be initiated. The Requests shall be forwarded to the Custodian using the "User Feedback Page" provided in this Document.

The Document Owner and the Document Custodian should ensure review and re-verification of this procedure every 5 years.

1.7 Step-out Approval

Not applicable to this guideline.

2 General Information

2.1 Information To Be Obtained Prior To Commencement Of Work

Prior to commencement of any site activity the Contractor shall obtain all essential design and operating data on the live pipeline and specific information on the sections of the line impacted by the activity. This information should include as a minimum:

- Pipeline identification, (name and code number)
- Pipe material, diameter and wall thickness
- Pipeline design data and operating conditions during the construction period
- Pipeline contents during the construction period
- Relevant Pipeline Alignment Sheets
- Pipeline coating details
- Details of wadi crossings, including concrete coating areas and gabion locations
- CP stations and test posts
- Environmental data (temperatures, humidity etc.)
- Latest pipeline integrity status report, location of existing sleeving or other repairs
- Other pertinent reports / data required to execute the work, (i.e. intelligent pigging reports, coating surveys etc.).

2.2 Information To Be Supplied By The Contractor

Prior to the commencement of any site activity, the Contractor shall submit to the Company for approval, all technical documentation regarding the way the activity / project will be performed. This documentation shall include as a minimum:

- Complete details of the project scope of work, to be executed by 3rd parties.
- Work procedures (method statements)
- Engineering calculations, (where applicable)
- Management and control procedures specific to the work
- HSE procedures specific to the work
- Emergency response procedure (in the event of pipeline damage)
- Submit to PDO Authorities a fully detailed list of all Equipments, Instruments, Sign Boards, Warning /Caution measures to be adopted during the site works, and also indicate whether any temporary or permanent Detours are required to carry out all site works in a safe and effective way.

No work shall commence until the documentation is signed as approved by the Company.

2.3 Safety Information

The Contractor shall at all times comply with the requirements of the Company's Safety Regulations, (HSE Manual).

All work sites which would otherwise constitute a safety hazard to the general public or to other workers shall be suitably roped or barricaded and warning signs installed. During the hours of darkness flashing warning lights shall be strategically placed around open excavations.

Where work is required in wadi areas, it shall be performed only after due consideration of flash floods and the risk to personnel safety and pipeline integrity.

2.4 Workmanship

2.4.1 Qualification of Operators

The operators of all mechanical equipment shall be required to undertake a short trial witnessed by the Company or its representative to demonstrate their competence in the use of that equipment. The Contractor shall maintain a register of operators accepted by the Company, which will be periodically checked by the Company. Under no circumstances shall an unregistered person operate equipment within the pipeline Right of Way. Failure to comply shall be treated as a serious breach of conduct.

2.4.2 Quality Control

The Contractor shall submit work procedures to the Company. Work shall not commence until documents have been approved. Any deviation from the approved procedures shall be treated as a non-conformance.

The Contractor shall submit a Quality Plan to the Company for approval. The Quality Plan shall conform to SP-1171. The quality plan shall make reference to each individual activity / Verification Point, the relevant Specification and clause, acceptance criteria (where applicable), method of recording each activity and responsible Party.

Activities shall not proceed beyond a nominated Verification Point until the work carried out to that point has been reported, inspected and approved by the Company's authorised representative. Verification Points include, but are not limited to, the following:

- Approval of documentation
- Confirmation of excavation location / boundaries
- Location of pipe by hand excavation
- Removal of surface soil / site preparation
- Approval of trench dimensions, access and stability / shoring
- Pipe ready for backfill
- Trench backfilled and compacted to support pipe
- Trench backfill and compaction complete
- Markers installed, windrow replaced and area reinstated

Compliance with procedures and specifications will be audited periodically by the Company. The Contractor shall at all times allow the Company or its representative's full access to information generated at site for the purposes of audits.

3 Preparatory Works

3.1 Site Responsibility

3.1.1 Access Roads and Rights of Way

Access to and from the pipeline Right of Way shall be along designated and existing access roads. The Company will normally approve access rights to the Right of Way only at points where the pipeline Right of Way intersects existing roads or tracks. Access at points other than those approved by the Company is not permitted. Where work involves crossing pipeline routes with heavy vehicles/ equipment other than at existing road crossings, engineering checks should be requested. (refer to 3.1.3).

Indiscriminate driving across open country is prohibited.

The Contractor shall ensure that any private access roads, bridges, culverts, wadi, bund or retaining earth mounds or similar structures to be traversed are first put in a fit condition to carry the Contractor's vehicles and that they are maintained at all times in a state of repair which will allow the owner, tenant, farmer or person entitled to use such structures full and unrestricted use for his stock, vehicles and equipment.

The Contractor shall maintain the pipeline Right of Way and access roads affected by the performance of the work. As a result of excavation and local conditions, it may become necessary to create diversions or change the boundaries of existing access roads or the pipeline Right of Way. Appropriate signs, night warning lights, reflectors etc. shall be installed in accordance with the Company HSE requirements, to advise traffic of the diversion and/or revised boundaries and to maintain a safe working environment for the performance of the work.

3.1.2 Company and Third Party Property

Prior to any work on site the Contractor shall examine the site and identify any existing structures, pipelines, cables etc., particularly buried facilities, by using metal detectors or alternative techniques approved by the Company. The location of all buried facilities and services shall be suitably marked and recorded.

Fences, gates and animal crossings used by the Contractor shall be maintained by the Contractor in a condition at least equal to that 'as found'.

Damage to items such as fences, gates, animal crossings, falajs etc. caused by the Contractor, his employees or vehicles shall immediately be restored to a condition at least equal to the original condition.

The Contractor shall be responsible for ensuring that closed or locked gates through which he passes will at all times be kept in the same status as found or as required by the owner, tenant or farmer etc.

3.1.3 Vehicle Crossing Points

Where it is necessary for the Contractor's vehicles or equipment to cross over any existing pipelines, (including the pipeline being worked on), this shall be done only at designated Crossing Points approved by the Company.

The Contractor shall propose to the Company the location of crossing points and, where required, the method of bridging to be constructed to protect the pipeline. Crossings shall satisfy the requirements of Standards STD-2-4101 for A/G pipeline & STD-2-4102 for U/G pipeline. The Company may require stress analyses to be performed to confirm the acceptability of the proposals. For carbon steel pipelines calculations shall be performed as per API 1102. No crossing point, whether bridged or otherwise, shall be used prior to approval by the Company.

The Contractor shall remove any temporary crossings when no longer required by the Contractor, or as instructed by the Company.

3.1.4 Permits

Before any work commences, the Contractor shall ensure that necessary permits have been obtained and approved by Company and approval to start the work has been given by Company Site Representative, as per PTW system document PR-1172.

The Contractor shall be responsible for obtaining all necessary permits to work at every location. In addition to the Work Permit issued by the Company, all excavation work within Company operational areas requires an Excavation certificate, in accordance with PR-1002. Work within the pipeline Right of Way may also require permits from National, Municipal or other Authorities.

The Contractor shall communicate with the relevant PDO geomatics and obtain their guidance and consent to carry out excavation works at the site.

Route survey works and pegging shall be carried out under the guidance of geomatics PDO Authorities only after obtaining the appropriate Permit to Work (PTW) and ,if applicable, Local Authorities. Post pegging Review and Approval from the concerned PDO Geomatics must be obtained in the approved PDO format prior to any exploratory digging/ excavation works.

3.2 Definition Of Excavation Site

3.2.1 Site Location

The Contractor shall verify the specified location of each excavation site independently of any existing marker peg.

Locations specified by the Company shall be verified by measurement of chainage from the selected reference point with an accuracy of ± 0.5 metres. Other techniques should be considered to aid accurate positioning where appropriate to the activity, (such as DCVG / CIPS for locating coating defects). The proposed techniques shall be included in the Method Statements to be submitted to the Company for approval under Section 2.2 of this guideline.

3.2.2 Site Marking

The centre and ends of each proposed excavated length shall be pegged directly above the pipeline axis.

Lateral alignment pegs shall be positioned to maintain the centre location after excavation has commenced and the centre peg has been removed. The alignment pegs shall be sited such that a line between them intersects the pipe axis at approximately 90° and such that they do not inconvenience the excavation working space, the spoil areas or Right of Way/access road.

The maintenance of survey pegs for the duration of the Scope of Work shall be the responsibility of the Contractor. Removed, damaged or incorrectly placed pegs shall be reinstated by the Contractor.

The excavation site shall be planned with respect to the anticipated length of excavation, the topsoil storage area, spoil storage areas, and equipment access. The excavation site shall be barricaded or roped off and appropriate warning signs/devices installed in accordance with the requirements of Specification and the Company HSE Manual.

4 Trench Excavation

4.1 General

Mechanical excavation is not allowed around live pipelines unless expressly permitted by the Company. Prior to commencement of excavation activities at each work site, the pipeline orientation and depth shall first be established by excavating a minimum of two pilot holes using either hand tools or vacuum methods.

The Contractor should be aware that in wadi areas wider than 100 metres, the windrow may be present in sections of only 25 metres separated by 75 metre gaps. The Contractor shall notify the Company if this is the case prior to any excavation, as the windrow should only be replaced in those 25 metre sections. The pipeline may also be protected with rock gabions.

If the excavation area covers any CP cables, posts or other facilities, the Contractor shall excavate around the facilities using hand or vacuum methods, taking care to avoid damage.

Excavated material (spoil) shall be deposited to one side of the trench. Top soil shall be separated from general spoil and shall not be removed from the site under any circumstances.

Natural drainage channels shall not be obstructed. Excavations shall be kept free from water during excavation operations and as far as is practicable at other times.

The Contractor shall maintain excavations in good condition and adequately barricaded and shored wherever necessary to prevent sidewall collapse. Shoring shall remain in position until all work has finished and the excavation is ready for backfilling. The shoring arrangements and all timber, jacks or other necessary materials shall be verified by a qualified engineer as fit for purpose and maintained in good condition by the Contractor.

Where a series of excavations is required along a pipeline, the work should be planned so as to minimise the time that the excavations remain open commensurate with maintaining the scheduled rate of construction. At no time shall the ground be opened in excess of that previously agreed and approved by the Company.

Note that any PDO ISSUED DRAWING indicating any below ground existing Pipelines, Cables, Tunnels, Utility Lines, Falaj, or any other potential obstacles are to be considered as **un-confirmed information and Data only to be verified and confirmed by the Contractor**.

It is the Contractor's Responsibility and Duty to utilize appropriate Below Ground Detectors to locate any and all types of obstacles using Metal Detectors, Sensors and other means of locating non metallic obstacles such as PVC, FRP, RTR, GRP, FOC.

Only non metallic hand tools and Vacuuming units will be used for pilot holes excavation at established points for digging. Mechanical Excavators, Diggers, Scrapers, Pneumatic Jack Hammers will NOT be permitted to carry out any exploratory Digging/Pilot Hole works.

When the complete excavation works are concluded, the peripheries will be cordoned off, Prominent Signs erected around the excavation, all shoring and means of ingress for personnel and for equipment will be inspected and the designated PDO Authority / Safety Officer will permit Personnel access to the exposed item to carry out any required work on the item, Pipe Line etc.

The exposed item to be worked on, and the point of physical contact, must be clearly identified, verified and confirmed in consultation with all concerned PDO and other relevant Authorities **before** any work related physical contact with the item, (such as 'removal of wrapping', 'blast cleaning' etc) takes place. This shall be treated as a Verification Point.

When all doubts regarding the working point has been resolved to the satisfaction of

PDO, the Site Supervisor must ensure that the Envisaged work on the exposed item can be carried out in Absolute Safety and adequate work clearance is prevalent at the point of work for the personnel and equipment designated to carry out the work, and all

Safety Measures are in place to safely execute the works as per the PDO approved Method Statement prepared by the Construction Contractor.

Earthmoving operations shall comply with the provisions of PDO Environmental Conservation Guidelines for Earthmoving Operations.

4.2 Spoil Areas

The topsoil shall be removed before trenching commences for a depth of 10 cm over the whole of each work area and for a distance of one metre beyond. Topsoil shall be stockpiled adjacent to the excavation in a discrete pile.

Topsoil shall at all times be kept separate from other excavated materials.

Topsoil shall not be replaced until the excavated trench has been backfilled and compacted in accordance with this Guideline, (refer to 5.3 for details).

All excavated material will be removed from the proposed worksite and deposited in a tidy manner (Windrow Material and Top soil separated) at a PDO designated point ,pending the decision whether to use the same material as Backfill.

Other excavated materials shall be piled at a safe distance from the excavation.

4.3 Trench Dimensions

Unless otherwise specified by the Company, the Contractor shall excavate along the pipeline axis a distance of 1 metre beyond the ends of the area demarcated for the subsequent work to be performed, i.e. ends of defects, location of repairs, etc. No excavation shall extend beyond the established Scope of Work limits, unless authorised by the Company.

The cross section of the excavation shall be made so as to provide sufficient access around the pipe for performance of the subsequent work. Actual dimensions will depend on the nature of the work, excavation depth and local soil and site conditions.

A detailed assessment shall be made by the Contractor to determine requirements for trench stability and pipe support and to confirm that significant movement of the exposed pipeline due to thermal expansion, lateral bending stresses etc. will not occur. The assessment shall be submitted to the Company as part of the method statements required for review and approval prior to commencement of work.

Where a series of closely spaced excavations is required along a pipeline, there shall be sufficient separation between each excavation to ensure that the stability of the pipeline bedding material and the trench wall is maintained. Otherwise supports shall be provided to the standard specified in 4.4.

The Contractor shall ensure that the trench walls will not collapse irrespective of the type of soil encountered. This may necessitate shallow angle trench sides, benching or shoring. Such precautions are mandatory under Company HSE requirements for excavations exceeding 1.2 metres in depth; Shoring shall be to a design and quality acceptable to the Company.

Shoring (if required) will be carried out using Approved for Specific Use Materials.

Once the location of below ground Obstacle to be excavated and exposed has been identified, only non metallic hand tools will be used to excavate / dig and expose the obstacle for whatever purpose.

The Contractor shall take account of the additional excavation necessary at points where the contour of the natural surface has required the pipeline to be buried at extra depth, such as approaches to highways, roads and wadis, or where the pipeline crosses below other buried lines or services.

The Contractor shall make ready access into the excavated areas at regular intervals so

that the work area on either side of the pipe has quick and convenient entry and exit points. Access ways shall be stepped and / or sloped. Excavations shall have a minimum of two access points, one at each end of the excavation on opposite sides of the pipeline. Long continuous excavations shall be provided with additional access points at intervals of no more than 20 metres.

4.4 Pipe Supports

Adequate support of the exposed pipeline shall be maintained throughout all stages of the work.

4.4.1 Permissible Unsupported Spans

Permissible lengths of unsupported pipelines shall not exceed the maximum values given in GU-629. For pipelines greater than 24" diameter and for all pipelines with significant wall loss defects, detailed stress analysis shall be undertaken by the Contractor to establish permissible unsupported lengths. Results of the stress analysis shall be submitted to the Company.

4.5 Supported Spans

When planned excavations will exceed or are to be extended close to or beyond limits established in 4.4.1, pipe support requirements shall be assessed and agreed with the Company. Any proposal to exceed the maximum unsupported span lengths shall be justified by stress calculations sufficiently detailed to demonstrate that at no stage of the work will stresses exceed the levels permitted in the applicable Pipeline Design Code. Risk of pipe movement on long excavations shall be analysed and measures taken to adequately brace / support the pipe to prevent such movement.

Installation of supports shall be carried out progressively. Excavation shall not be permitted to extend beyond the specified maximum length until a support is satisfactorily installed.

The pipe supports shall maintain the pipe in its original (pre-excavation) position, both vertically and horizontally. There shall be no pipe displacement whatsoever during excavation and backfill. This shall be monitored by elevation measurements on the pipe at the ends and centre of the excavation and at each support location as excavation is progressed and on a daily basis prior to backfill. Care should be taken to ensure that benchmarks are preserved during excavation operations or adverse weather conditions, flooding etc.

If a support must be moved for any reason, e.g. to enable access to the pipe at the support location, its removal shall not increase the unsupported pipe span length beyond the limit specified.

The Contractor shall propose a design of pipe supports for approval by the Company. The design shall include engineering calculations to verify the suitability of the supports for the anticipated loads. The following minimum design criteria shall be included:

- a base of sufficient area to prevent the supports sinking into the ground
- a construction that prevents the supports from compacting under load
- a material that is capable of withstanding the imposed load
- suitable padding to provide a reasonable surface area of support and to prevent damage to the pipe or to the external coating
- a design factor of 2.

If wooden supports are to be used, the wood shall be of a suitable type and grade, and shall be of good quality, free from knots or other discontinuities. Acceptable types of wood for skids and supports are oak, ash and redwood. Supports shall be maintained in good condition throughout their use, requirements being included in the Contractor's QA/QC procedures.

Air bags shall not be used for other than short-term auxiliary support to aid in the

installation or removal of other supports. To ensure redundancy in the event of failure of an air bag and to ensure failure of one will not cause catastrophic failure of all the others, at least two air bags shall be deployed at each support point and the air bags shall have a design safety factor of at least four times the anticipated load.

4.6 Hand And Vacuum Excavation

The pipeline shall always be exposed initially using hand or vacuum methods. When sufficient trial holes have been dug to establish the depth and orientation of the pipe and the location of both sides of the pipe are clearly defined, the required minimum offset distance from the top centre of the pipe shall be marked out on each side of the length to be excavated.

Where mechanical methods are permitted, mechanical excavation may then commence at each side of the pipe up to the marked areas. Hand or vacuum methods shall be used to excavate the pipeline within the marked area and shall be used exclusively in exposing CP related facilities.

If vacuum excavation is used, ear defenders, dust masks and safety goggles must be worn by the operator and all personnel working in the vicinity. These are in addition to other mandatory Personal Protection Equipment specified by the Company HSE Manual.

4.7 Mechanical Excavation

Mechanical excavation (where approved by the Company) may not commence until pilot holes have been manually excavated and the working areas marked as described in Section 4.1, so that excavation limits are clearly visible to the excavator operator.

For the mechanical removal of the windrow and the topsoil layer immediately above the pipe, only flat mouth (non-toothed) buckets shall be employed.

PDO Approval must be obtained for Excavation using Machinery at whatever location, even after Hand Excavation / Vacuuming establishes that there are **no Below Ground Obstacles** to be encountered at the point of excavation.

Mechanical excavation shall be performed parallel to the pipe axis and shall maintain a minimum lateral separation of 1m between the bucket / shovel and the pipe. All operators shall be made fully aware of the implications of making contact with the pipeline and shall use machine tools with the greatest of care. The excavating machine shall not be used in a transverse direction to the pipeline under any circumstances.

The Contractor shall use a banksman, whose duty is to direct the excavator operator and to notify the operator and the Company's representative of any infringements of the 1m exclusion zone each side of the pipe. The banksman shall be present during all mechanical excavation operations. Hitting the pipeline with an excavator is regarded by the Company as a serious incident and must be reported to the Company immediately for closer investigation.

Plywood shields or padding, such as thick sheets of polyurethane foam, shall be positioned around the pipe during mechanical excavation.

4.8 Excavations Crossing Existing Services

Crossing of live pipelines, cables and other underground or above ground services may be required during new construction, excavation of an existing pipeline or during excavation for the construction of roads or other facilities. The Contractor shall identify existing services within the working area from the as-built drawings, pipeline alignment sheets and from field surveys, using metal detectors and other suitable equipment. PDO survey services can be asked to provide coordinates for use with GPS' equipment. Before commencing any excavation, the Contractor shall define and peg out the positions of all such buried features within the immediate working area.

Excavation of marked lines and cables shall be confined to manual techniques, particular care being exercised in the use of pickaxes and similar penetrating

implements. Once hand excavation has clearly defined the extremities and routing of the services, mechanical excavation can proceed to a minimum distance of 1 metre from the services, provided operations are continually monitored by the banksman, (refer to 4.7).

Where excavation of live pipelines needs to be extended below other lines and services, the Contractor shall be responsible for their proper support and protection throughout excavation and subsequent work within the trench. The Contractor shall also reinstate backfill and protection of the services to the original standard during compaction and backfilling of the trench.

5 TRENCH BACKFILL

5.1 GENERAL

The Contractor shall not commence backfilling until the work has been inspected and approved by the Company. Backfilling operations shall meet the requirements of SP-1208 and this Guideline. The materials and disposition of layers shall be in accordance with Table 1 and Figure 1 of this guideline.

Bedding and backfill shall be placed in a manner that will ensure:

- the final position of the pipeline is identical to its position before excavation
- damage does not occur to the pipe or its protective coating

Where excavation has been conducted beneath the pipeline, it is essential that all the backfill beneath the pipe is fully compacted, to ensure that the pipeline is not subsequently affected by subsidence. The procedures to be used will depend on access beneath the pipeline, the length of excavation and local site conditions and shall be detailed in the Method Statements agreed by the Company, (see below). Compaction shall normally be done by manually ramming thin layers from each side of the trench, compaction being continued until no further movement is discernible. If a sufficiently high degree of compaction cannot be assured by this means it may be necessary to backfill from the trench bottom up to and around the pipeline, (Figure 1, layers 1 and 2), entirely with rammed sifted sand of maximum size 3 mm.

As backfilling progresses the Contractor shall remove all shoring and other temporary materials and equipment from the excavation, with due regard to the safety of personnel working within the trench. Any material disturbed during these operations, which does not comply with the infill requirements of Table 1 of this guideline, shall be removed.

No temporary pipe supports shall be left in the trench or covered over with backfill material. Backfilling should progress towards existing support and support removal shall be performed in such a manner that the pipeline span lengths never exceed the specified requirements. This may require the insertion of additional temporary support, e.g. compacted soil or sand bags, under the pipe to enable padding and compaction to be carried out along the remaining span before removal of the main supports and local completion at the temporary support points.

The Contractor shall include full details of the proposed backfill and support removal procedures, (including provision for protection of pipe coatings from damage at support points), in the Method Statements required for Company approval under 2.2 of this guideline.

Windrows shall be reinstated to a minimum height of 1 metre to mark the position of and protect the pipeline.

5.2 Backfill Materials

The Contractor shall not use, disturb or interfere in any way with material previously removed and stockpiled by others. All materials for backfill, other than those removed from around the pipeline by the Contractor, shall be subject to approval by the Company.

The Contractor shall ensure that the following deleterious materials are not included in the trench or backfill:

- Rock larger than 100 mm in any dimension.
- Waste coating materials or metallic artefacts of any kind
- Pipeline supports, shoring, vegetation or other organic material.
- Any rubbish including camp waste, packaging etc.
- Gypsum or any material with chloride content greater than 100 ppm.

Excavated spoil, sifted to remove rocks, shall generally be used as backfill. The fine padding material to be placed around the pipe, (see Figure 1), shall be free from clay. Padding may be obtained from the spoil heaps by sifting and/or processing using rock crushing machinery, or from other sources approved by the Company. Topsoil shall not be processed to create fine padding.

Waste materials shall be removed from the site and disposed of to the requirements of the Company.

Topsoil shall always be used as the final layer prior to windrow reinstatement.

Table 1 - Backfill Requirements

| Layer | Description | Material Grading ⁽¹⁾ |
|-------|---|---|
| 1 | Trench bottom to 150 mm beneath pipe | Maximum ⁽²⁾ :rock - 100 mm clay - 50 mm |
| 2 | 150 mm beneath pipe to 250 around and over the rest of the pipe | Sifted sand to maximum 3 mm |
| 3 | 250 mm over pipe to 500 mm over pipe | Sifted spoil to maximum 25 mm |
| 4 | 500 mm over pipe to 150 mm natural ground level | Sifted spoil to maximum 100 mm |
| 5 | 150 mm below natural ground level to natural ground level | Topsoil |
| 6 | Ground level to minimum +1.0 metres | Undifferentiated spoil |

NOTES:

1. Maximum dimension shall be defined as the maximum measurement across the particle taken in any orientation.
2. Sifted sand to maximum 3 mm may be substituted for layer 1 where a consistently high level of compaction cannot be assured.

5.3 Compaction and Backfill

The trench shall be backfilled in discrete layers. Compaction shall be performed as layers are placed in the trench. The layers and a description of their extent are given in Table 1 and shown diagrammatically in Figure 1.

The backfill shall be compacted to ensure that there will be no subsidence of the trench. Hand ramming shall be used for intermediate layers. Mechanical compaction methods may be employed for completion of backfilling.

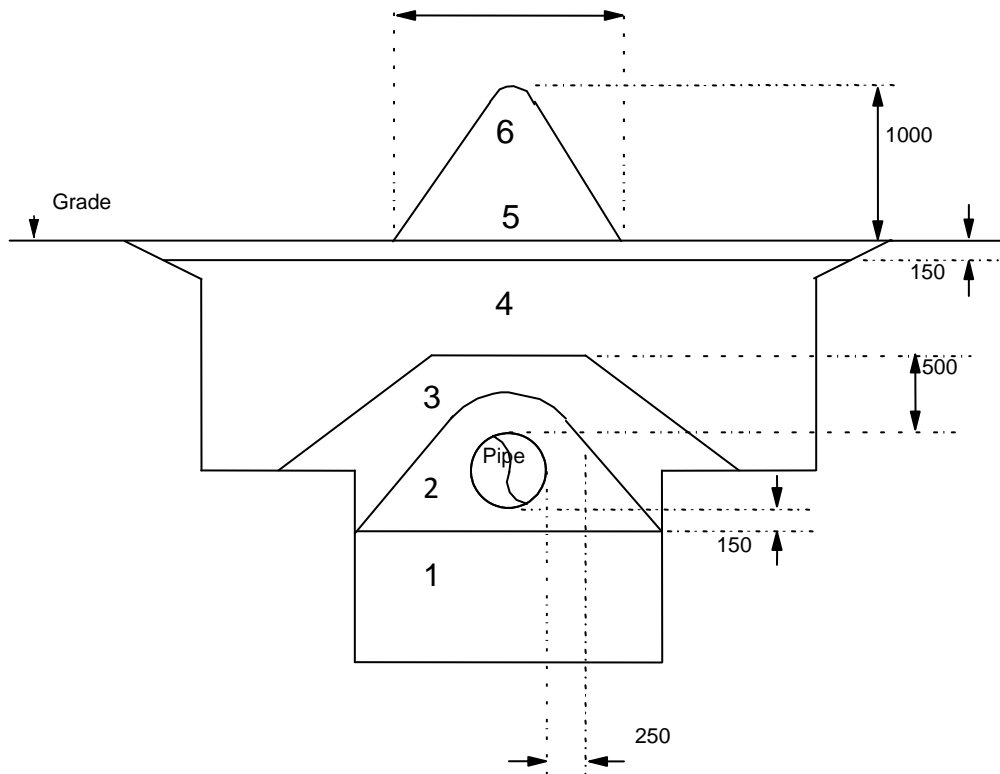
Compaction shall be performed after deposition of each 300 mm depth of loose material or

at every interface between layers, whichever is the lesser.

The Contractor shall compact the layers of backfill, from the bottom of the trench to 150 mm below the pipe, in accordance with the procedure established by site testing, (refer 5.1 of this guideline). The remaining layers shall be compacted to a consistently high level.

Topsoil shall be replaced only after the trench has been backfilled and compacted and the work approved by the Company. The topsoil shall be heaped without compaction to allow for any subsequent subsidence.

Figure 1 - Trench Backfill Requirements



All dimensions in mm

Refer to Table 1 for descriptions of numbered layers

5.4 Pipe Coatings

Prior to backfilling, visual inspection and holiday detection testing of all exposed coatings immediately prior to backfilling. Any coating defects shall be repaired in accordance with SP-1246.

If the removal of shoring at the commencement of backfilling operations results in a collapse of the trench wall, repeat holiday detection of any affected coating shall be carried out and repairs completed as necessary.

The time span between approval to backfill and backfilling shall be minimised. If it exceeds 24 hours the pipe coating shall be re-tested for holidays immediately prior to backfill and repaired as necessary.

5.5 Reinstatement

The contractor shall reinstate any areas or objects damaged or altered during construction such that their final condition is equal to or better than their original condition. This shall apply regardless of whether the areas or objects are inside or outside the pipeline right of way.

During the period of construction, the contractor shall be responsible for the routine maintenance of the pipeline right of way and any access roads or tracks used by contractor's vehicles.

On completion of construction, roads, the pipeline Right of Way and other working areas shall be left in a neat and clean condition to the satisfaction of the local authority, the property owner or occupier as communicated to the Contractor by the Company.

Any bridges must be restored to their original state of repair to the approval of the Company.

Any additional protection to pipelines and coating systems specified under crossings or elsewhere shall be reinstated by the Contractor in accordance with the relevant specifications.

Sand hills etc. shall be reinstated to the condition existing at the commencement of construction.

6 Permanent Marking Of Pipeline Repairs

Every pipeline repair location shall be indicated by placing a permanent marker on the pipeline-offset line, immediately adjacent to the repair. The markers shall always be positioned at the upstream end of the repaired section.

The Contractor shall supply and install the permanent markers during or immediately following the completion of reinstatement at each location.

The markers shall comprise a standard test post and sign of Company approved design. Lettering shall be in English and Arabic and shall comprise:

- Pipeline identification and diameter
- Chainage (KP)
- Repair identification (e.g. pipeline repair, recoating, date repair undertaken etc.) and length of repair.

The Contractor shall provide the Company with a list of the positions of all permanent markers installed along the pipeline. The list shall repeat the information given on the marker post and additionally quote the repaired length of pipeline, the actual chainage and any other pertinent information.

Third party facilities/utilities across/within the pipeline ROW: an adequate marking shall be agreed.

7 Documentation

On completion of the work the Contractor shall provide a suitably bound Close Out Report comprising complete records of all activities including inspection reports, photographs, non-conformances, site memos, faxes, permanent marker lists and 'as-builts' of pipeline route maps.

The Close Out Report should be compiled on an ongoing basis throughout the execution of the work. To assist this, prior to the work commencing, the Contractor shall issue a Close Out Report Index to the Company for review and approval.

8 References

8.1 Publications:

Government Laws

Oil and Gas Royal Decree 08/2011

PDO Standards

| | |
|---|---------|
| Project Engineering CoP | CP-117 |
| Health, Safety and Environmental Protection | CP-122 |
| Pipeline Emergency Repair Manual | GU-379 |
| Application & Selection of Standard Pipe Supports | GU-629 |
| Excavation Certificate | PR-1002 |
| HSE Specification - Land Management | SP-1012 |
| HSE Specification - Environmental Permitting | SP-1013 |
| Specification for Welding on Pressurised Pipes | SP-1167 |
| Specification for Quality Management System Requirements | SP-1171 |
| Permit to Work System | PR-1172 |
| Specification for welding of class 2 pipelines | SP-1174 |
| Specification for welding of class 1 pipelines | SP-1177 |
| Pipeline Construction Specification | SP-1208 |
| Pipeline Repairs | SP-1235 |
| Inspection, Maintenance and Repair of Existing Painting and Coating Systems | SP-1246 |

Shell Standards

| | |
|---|----------------------|
| Hot Tapping on Pipelines | DEP 31.38.60.10-Gen. |
| External field joint and rehabilitation coating systems for line pipe | DEP 31.40.30.37-Gen. |


8.2 PDO Standard Drawings

STD-2-4101

STD-2-4102

STD-2-4108

Appendix 1 – User Feedback Page

| | | | |
|---|---|--------------|--|
|  | GU-501 – EXCAVATION AND WORKING AROUND LIVE PIPELINES USER FEEDBACK PAGE | | |
| | Any user who identifies an inaccuracy, error or ambiguity is requested to notify the custodian so that appropriate action can be taken. The user is requested to return this page fully completed, indicating precisely the amendment(s) recommended. | | |
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