دبي للبترول
Dubai Petroleum

هيئة دبي للتجهيزات
Dubai Supply Authority

DUSUP GUIDELINES FOR UTILITIES CROSSING HYDROCARBON PIPELINES

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Approval

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1 INTRODUCTION

Dubai Supply Authority (DUSUP) provides energy supply (Natural Gas) to Emirate of Dubai to meet the needs of electricity generation and water desalination through its pipeline network, Through the production of natural gas (which is processed into gas and condensate products), the purchase of pipeline gas and LNG (and its regasification), gas storage and the operation of the pipeline network, DUSUP plays a key role in the growth and development of Dubai.

DUSUP has assigned Dubai Petroleum Establishment (DPE) the responsibility for operating DUSUP assets and authorised DPE to manage all emergency events occurring on its own operated facilities, pipelines and assets within pipeline corridors in liaison with other governmental entities.

DPE-DUSUP designs operates and maintains DUSUP's onshore pipelines and related facilities to International Standards in order to ensure an uninterrupted flow of gas and other hydrocarbons across Dubai.

There are approximately 700 kilometres of onshore hydrocarbon pipelines operating in Dubai. The gas pipelines operate at high-pressures up to 960-psig and transport highly explosive and flammable natural gas. A number of jet fuel and fuel oil pipelines share the corridors with the gas and condensate pipelines.

2 PURPOSE

The purpose of this guideline is to assist the DUSUP/DPE NOC staff for NOC review, DUSUP/DPE field staff for monitoring safe execution of utilities crossing existing DUSUP/DPE pipelines and a guide for NOC applicants (Consultants & Contractors) on the requirements for NOC application acceptance.

3 REFERENCES

DUSUP, NOC Standard Conditions - DP-OPSON-0056

DUSUP, Guidelines for Trial Pit - DP-OPSON-0148

DPE, Hot Work Procedure - DPE-HSE-00044

DUSUP, Guidelines for Dewatering Works - DP-OPSON-0187

DUSUP, DEWA Work within Hydrocarbon Pipelines NOC Zone (DP-OPSON-0156).

4 ABBREVIATIONS & DEFINITIONS

4.1 Abbreviations:

Abbreviation	Description
ALARP	As Low As Reasonably Practicable
BHA	Bore Hole Assembly
CP	Cathodic Protection
DPE	Dubai Petroleum Establishment
EMARAT	Emirates General Petroleum Corporation
EMDAD	EMARAT, Air BP and Shell Joint Venture
ENOC	Emirates National Oil Company

Abbreviation	Description
e-NOC	Electronic NOC
GCS	Gas Control Station
HDD	Horizontal Directional Drilling
HSE	Health, Safety and Environment
HV Cable	High Voltage Cable
LEL	Lower Explosion Limit
LV Cable	Low Voltage Cable
MDD	Maximum Dry Density
MS	Method Statement
MSRA	Method Statement and Risk Assessment
MT	Micro Tunnelling
NDC/NDCM	Non-Disruptive Crossing / Non-Disruptive Crossing Method
NDRC	Non-Disruptive Road Crossing
NOC	No Objection Certificate
OHL	Over Head Line
PJ	Pipe Jacking
PPE	Personal Protective Equipment
PPV	Peak Particle Velocity
PTW	Permit to Work
RA/TRA	Risk Assessment/ Task Based Risk Analysis
RCC	Reinforced Cement Concrete
ROW	Road Right of Way (of RTA)
RTA	Roads and Transport Authority
TB	Thrust Boring

4.2 Definitions:

Term	Definition
Accident	The unexpected and undesirable occurrence directly associated with DUSUP operations and DUSUP asset/facility, which results or may result in human casualties or damage to property.
ALARP	In risk assessment when the risk is assessed and controlled the residual risk shall be reduced to ALARP(as low as reasonably practicable)

Term	Definition
Benching	Benching is a type of safe excavation method in which sides of trench are formed in steps in order to prevent them from collapsing. Benching is also called as Step cutting.
Berm	A soil bund built over the pipeline as a protection cover.
Cathodic Protection	Cathodic Protection (CP) is a technique used to control the corrosion of a metal surface by making it the cathode of an electrochemical cell. A simple method of protection connects the metal to be protected to a more easily corroded “sacrificial metal” to act as the anode.
Construction	The erection of any new buildings or structures, or the variations to the infrastructure facilities or existing asset.
Consultant	A natural or legal person who is offering advice/consultation on engineering, technical, or any other matter related to design and construction.
Contractor	An organization designated by the Owner or the Operator for the purpose of carrying out the works related to Construction, or execution of any work that requires obtaining of No Objection Certificates from the DUSUP.
Control Measure	Provisions to reduce identified risks.
Corridor Intersection	Common area covering crossing of two corridors at the intersection of DUSUP corridor and RTA ROW.
Cave-in	Cave-in means the movement of soil or rock into an excavation, or the loss of soil from under a trench shield or support system, large enough to trap, bury/injure and immobilize a person.
DPE	Dubai Petroleum Establishment responsible for the Operation of DUSUP Asset.
DUSUP Corridor	DUSUP Corridor is the land allocated by Dubai Municipality or other statutory government authority to DUSUP for the construction, operation and maintenance of gas and fuel pipelines in the emirates of Dubai.
e-NOC	The electronic NOC application that can be submitted via the online system: https://noc.rta.ae/RTAeNOC/Webpages/common/login/login.aspx
Excavation	Excavation is a man-made cut, cavity, trench or depression formed by earth removal.
Gyro Steering	Gyro steering relays accurate navigation information from the drill head to the operator in real-time without the effect of external influences. Gyro steering works through a tool which is mounted behind the jetting assembly.
Hazard	A Hazard is any source of potential damage, harm or adverse effects on people, property environment or organization.

Term	Definition
Horizontal Directional Drilling (HDD)	HDD is a minimal impact trenchless method of installing underground utilities in a relatively shallow arc or radius along the prescribed path using a surface launched drilling rig.
Manual Excavation	Manual Excavation is also called as Hand Excavation, which is carried out by use of hand shovel.
Manual Excavation Limit	Excavation within 5 meter of pipeline must be carried out by Manual Excavation.
Micro Tunnelling (MT)	Micro tunnelling is a pit launched trenchless installation technique and uses laser-guided steerable remote control for live monitoring for real-time correction capability.
No Objection Certificate (NOC)	A document approved by the DUSUP through e-NOC, for the technical design of proposed development or authorizing a contractor to carry out a Construction/Restricted Activity within the NOC Zones.
NOC Zone	DUSUP NOC Zones are: • 60 meter either side from the center of pipelines or 60m either side of DUSUP Corridor limit, whichever is greater. • 10 meter either side of the pipelines line for the pipe lines located within DEWA or EGA (DUBAL) Plot limits. • 5 meter either side from the center of 8”Shell pipeline (Abandoned, Positively Isolated). • 300 meter for High Voltage Over Head Lines parallel to hydrocarbon pipelines/pipeline corridor. • 500 meter for Subsea Pipelines. • 500 meters for Land Use Planning adjacent to DUSUP Pipeline/Pipeline Corridor. • Margham Field Safety Zone. • 10m radius buffer for all abandoned wells (Positively Isolated).
Non-HDD	Trenchless crossing method other than horizontal directional method, i.e. Micro Tunnelling, Thrust boring, Pipe Jacking methods.
Observation Pit	An Observation pit or Daylight Inspection pit is excavated to witness and confirm the safe crossing of HDD pilot and reamer below existing hydrocarbon pipeline.
Open Cut	Open cut excavation is a traditional method of excavation by opening up the surface of the ground to the required depth.
Permit to Work (PTW)	A written or digital approval granted by DPE that authorises a person or persons to carry out specific work within a specified time frame within the proximity of DUSUP asset/plot boundary limit.

Term	Definition
Pipe Jacking (PJ)	Pipe Jacking is a method of laying underground pipeline by assembling the pipes at the foot of an access shaft and pushing them through the ground using hydraulic jacking rig.
Pipeline Representative, Pipeline Operator or Patrol staff	The staff designated by DUSUP the duties of witnessing NOC works for compliance with NOC conditions and monitoring the safety of the pipelines.
Risk	A situation involving exposure to danger
Risk Assessment	A report prepared by the Applicant/Customer seeking DUSUP NOCs, identifying potential risks and mitigation measures involved in carrying out any Construction or Restricted Activity within the DUSUP NOC Zones.
Safety	The absence of any risk of harm or damage to the people, DUSUP asset/Infrastructure that is deemed unacceptable as per the DUSUP/DPE Safety Regulation or Standard Operating Procedure.
Shielding	Trench Shield also called Trench boxes which is installed inside the trench to protect the worker from potentially dangerous soil collapse, Shielding does not prevent the trench collapse.
Shoring	Shoring is the provision of a support system for trench faces used to prevent soil collapse, cave-ins.
Sloping	Sloping (sloping system) is a type of safe excavation method in which sides of an excavation that are inclines away from excavation so as to prevent cave-ins.
Trenchless Crossing	The method of construction of underground utility crossing between the two defined points without continuous, open cut excavation between them and without causing disturbance to the ground or assets above. (e.g., Pipe Jacking, Thrust Boring, Micro Tunnelling, horizontal directional drilling etc.,)
Thrust Boring (TB)	Thrust boring is jacked and drilled trenchless boring method used for the installation of utility between the Entry and Exit pit.
Utilities	Utilities are means of supply of essential services such as electricity & communication through cables, water, drainage and natural gas or fuel oil through the pipelines.
Utility Owners	Owners of utilities such as: drainage lines (DM), Electricity & Water (DEWA), ITS Services (RTA), Telephone (Etisalat, Du), Other communication cables(UAE Armed Forces), etc.,
Walkover System	This method of HDD monitoring system utilizes an electromagnetic signal from a transmitter located directly behind the drilling head. The signal is received by an antenna (handheld locator) being able to Walk Over the top of the drill head to accurately monitor its progress. The

Term	Definition
	information received on the surface details the drill's lateral position, depth, pitch, and roll. This data allows the drilling team to steer the drill along the desired path/route.
Wire-Line System	In this method of HDD monitoring, information on position, inclination and roll is relayed from the steering probe (tool) back to the drill rig via a continuous wire connection installed inside each individual drill rod, allowing accurate steering where overhead locating is not possible. To overcome magnetic interferences and increase overall positional accuracy a surface cable loop is laid above the axis of the bore and connected to a power source to generate an artificial magnetic field. The measurement probe can now be referenced to this known field eliminating outside interference.
Witnessing Zone	Work within 10 meters of hydrocarbon pipeline can only be carried in the presence (witnessing) of DUSUP Pipeline Representative in order to witness and record safe implementation of NOC work.

5 UTILITIES CROSSING EXISTING HYDROCARBON PIPELINES

New utilities may cross existing DUSUP/DPE pipelines or DUSUP corridor in various locations of Dubai. The design and construction of such crossings within DUSUP's NOC zones require review and approval through the NOC process.

Approval of utilities crossing through the DUSUP corridor (including within ROW) shall not infringe upon DUSUP's right to unrestricted use of corridor for the operation and maintenance of existing pipelines and construction of future pipelines.

The following are the various types of utility crossings covered under this guideline document:

- Open Cut Utility Crossings
- Trenchless Utility crossings
- Overhead Lines (OHL) Crossings.

  Note: Only two layers of utilities must be present at each crossing location. i.e., once an approval is granted for third party utility to cross below the existing pipeline, all subsequent third-party utilities shall only cross below existing pipeline. Similarly, once an approval is granted for third party utility to cross above the existing pipeline, all subsequent third-party utilities shall only cross above existing pipeline.

Subsequent sections stipulate the minimum requirements to be followed to obtain an NOC.

6 NOC TYPES & SUBMISSION REQUIREMENTS

For the Utilities crossing DUSUP/DPE pipelines or DUSUP corridor within the NOC zone, following DUSUP NOCs are applicable:

- Information NOC
- Concept Design NOC/Preliminary Design NOC
- Final Design NOC
- Trial Pit NOC.
- Construction NOC

- Final Clearance NOC / NOC Close-out

6.1 Information NOC

Existing, planned pipeline and related facility information along with the corresponding DUSUP Guidelines and Standard DUSUP NOC Conditions are shared with the applicants (consultant or contractor) for the design and construction of proposed utility crossing work through the RTA's e-NOC System.

6.1.1 Information NOC - Submission Requirements

a) AutoCAD drawing on DLTM coordinates datum showing the proposed Project Limit Plan for issuing Pipeline Information.
b) Pdf file of drawing showing proposed Project Limit Plan for issuing Pipeline Information.
c) For issuing pipeline information, it is mandatory for the applicant to submit a confidentiality undertaking letter as per the DUSUP approved letter template. The Confidentiality Undertaking Letter template can be downloaded from DUSUP website using link: https://www.dusup.ae/noc
d) Undertaking letter must be submitted with company stamp and signed by the authorized company representative.

Note: Information NOC will be issued with DUSUP Standard NOC Conditions, AutoCAD file of existing pipeline information, corridor limits, corridor fence and gate locations, desert crossings and other facilities such as valve station fence and pigging fences, with applicable guidelines.

6.2 Concept / Preliminary Design NOC

Concept NOC/Preliminary Design NOC are initial design proposal seeking input and approval in order to proceed with the Final Design.

6.2.1 Concept / Preliminary Design - Submission Requirements

a) Key Plan showing project location.
b) General Layout Plan/Route Plan incorporating existing site condition, existing other utilities, and proposed work, DUSUP corridor limit, pipelines/ facilities as provided in Information NOC.
c) AutoCAD file of General Layout Plan/Route Plan drawing prepared on DLTM coordinates datum.
d) Typical Cross Section drawings showing existing site condition, existing utilities and proposed crossing including DUSUP corridor information provided through the Information NOC.
e) Method of proposed crossing (i.e., Open cut or Trenchless method).
f) Include applicable notes from the DUSUP Standard NOC Conditions and DUSUP Guidelines in the drawing.

Gravity fed utilities require to have their design fixed as early as possible during the design phase. For such designs, trial pits may be required at a very early stage of the design such that there is no conflict between the proposed gravity fed line level, and the existing DUSUP pipelines level. It is therefore recommended that the consultant / contractor undertake trial pits on the DUSUP pipelines as early as possible for gravity fed projects, to ensure adequate design.

6.3 Final Design NOC

Final Design NOC is submitted after incorporating Concept NOC / Preliminary Design NOC conditions. A check list for Concept / Preliminary Design NOC conditions compliance must be included in the submission of Final Design NOC.

6.3.1 Final Design NOC - Submission Requirements

a) Key Plan showing project location.
b) General Layout Plan/Route Plan incorporating existing site condition, existing other utilities, and proposed work, DUSUP corridor limit, pipelines/ facilities as provided in Information NOC.
c) AutoCAD file of General Layout Plan drawing prepared on DLTM coordinates datum.
d) Cross Section drawings showing the existing site condition, existing utilities and proposed utility crossing including DUSUP corridor information provided through the Information NOC, minimum clear vertical separation from the existing pipeline to the proposed utility crossing and any element of work that may have direct or indirect effect on the existing DUSUP pipeline or DUSUP assets.
e) ROW cross section drawing for corridor intersection areas must show the existing road & ground profile extending to DUSUP corridor, existing and proposed utilities.
f) The layout and details of permanent structures, manholes/valve chambers/shafts in the proximity of corridor and separation distance from the corridor/existing pipelines must be included in the drawings.
g) Method of proposed crossing (i.e., Open cut or Trenchless method).
h) HV OHL crossing must include separation distance from the foundations to DUSUP corridor / HC Pipeline.
i) HV OHL cross section drawing must show minimum clearance from the lowest conductor level to the ground.
j) Proposed HV OHL constructed parallel to DUSUP corridor or pipeline and falls within 300 meters distance from the corridor or pipeline must be included in submission.
k) Include applicable notes from the DUSUP Standard NOC Conditions and DUSUP Guidelines in the drawing.
l) Applicable design requirements mentioned in this document shall be considered for the design and drawing.
m) Checklist for Concept Design / Preliminary Design NOC conditions compliance.

6.4 Trial Pit NOC

To finalize the crossing details and to proceed with Construction NOC submission, existing HC pipeline locations shall be verified by trial pits at the crossing location. A separate Trial Pit NOC request with a plan drawing and proposed location of trial pits must be submitted for DUSUP approval prior to commencement of any trial pit work.

For Trial Pit NOC Requirements refer to:

DUSUP Guidelines for Trial Pit: DP-OPSON-0148

6.5 Construction NOC

A valid Construction NOC must be available at site before commencement of any construction activities within the DUSUP NOC Zones.

6.5.1 Construction NOC - Submission Requirements

Separate Construction NOC submission may be required for each crossing location as the location specific hazards may require separate control measures and procedures.

Construction NOC submission must include but not limited to following:

a) Completed check list for Design NOC condition compliance.

b) Key Plan Showing Project Location.

c) General Layout Plan/Route Plan incorporating existing site condition, existing other utilities and proposed work, DUSUP corridor limit, pipelines/ facilities as approved in Final Design NOC.

d) Detail Cross Section drawings showing:
   i. All existing utilities.
   ii. Temporary support and protection details of affected DUSUP Pipeline (for Open cut only) and utility owners approved protection to any other affected utilities.
   iii. The elevation of existing ground, pipeline berm, proposed finished ground and DUSUP corridor limit as per trial pit verification (attach a copy of DUSUP verified trial pit record).
   iv. Vertical separation from the existing pipeline to the proposed crossing, elevations and location coordinates consistent with the trial pit verification.
   v. Trench protection details, as applicable.
   vi. Dewatering details, if applicable.
   vii. Job specific and location specific method statement and risk assessment reviewed and approved by the consultant or client.

e) Concrete identification slab between the existing HC pipeline and proposed utility and cable marker tape above cables for open cut crossing (refer to Attachments 1-5 for details).

f) The layout and details of manholes/valve chambers/shafts and proposed separation distance from the corridor/existing pipelines must be included in the drawings.

g) DUSUP patrolling access layout for utility crossing above HC pipeline (if affected).

h) Include applicable notes from the DUSUP Standard NOC Conditions in the drawing.

6.5.2 Specific Construction NOC Submission Requirements for Trenchless Crossings

a) The trenchless crossing must be risk assessed by clearly identifying the existing HC pipeline and hazard associated with the crossing of existing HC pipeline. RA must also cover construction of entry and exit pit, dewatering works and any equipment failures such as breakage or trapped pilot / reamers at the drilling route and its retrieving procedure. RA shall be approved by the Consultant or competent client's representative before submission.

b) Method Statement (MS) shall be job specific, location specific, task based and approved by the Consultant or competent client's representative before submission.

c) MS for HDD shall describe safe execution of observation pit requirements including backfill and compaction to the approval of DUSUP/DPE.

d) HDD crossing profile drawing shall be submitted as per the DUSUP approved sample drawing (See Attachment - 7)

e) Dewatering proposal at entry and exit pits of non-HDD crossing must be included in the submission.

f) Non-HDD Trenchless crossing submission must include construction details of Entry/Launching Pit and Exit/Receiving Pit, including all proposed concrete work with thickness, dimensions, and corresponding elevations for easy verification at site. Profile drawing shall be submitted as per the DUSUP approved sample drawing (see Attachment-8).

g) Crossing Coordinates (DLTM) and Elevations at top & bottom of pipeline(s), elevation of existing ground surface, top of berm & bottom of berm.

h) Proposed minimum clearance from bottom of pipeline to top of utility/sleeve/conduit depicted as below:

- For Walkover HDD Method, Observation Pits are a requirement with minimum 2.0 m vertical separation for maximum size of reamer diameters up to and including 1.0 m, and two (2) times maximum size of reamer diameter, if the maximum reamer size is greater than 1.0m in diameter.

- Wireline / Gyro System HDD Methods can be proposed without an Observation Pit, with 5 m clear vertical separation distance measured from the bottom of HC pipeline to crown of maximum size reamer. With an Observation Pit, separation distances shall be minimum 2.0 m for diameters up to and including 1.0 m maximum size of reamer, and two (2) times maximum size of reamer, if the maximum reamer size is greater than 1.0m in diameter.

- For Non-HDD Trenchless Method (i.e. Micro Tunnelling, Thrust boring, Pipe Jacking), minimum 2.0 m vertical separation for diameters up to and including 1.0 m sleeve/casing size, and two (2) times sleeve/casing size if greater than 1.0 m diameter sleeve/casing size.

Type	Observation Pit	Vertical Separation Distance
HDD Method (Walkover)	Required	2m or 2 x Reamer Size (whichever is greater)
HDD Method (Wireline / Gyro)	If Provided	2m or 2 x Reamer Size (whichever is greater)
	If Not Provided	5 m minimum.
Non-HDD Method	N/A	2m or 2 x Casing Size (whichever is greater)

i) Minimum horizontal distance between edges of launch/receive pit to edge of pipeline shall be 15 meters minimum, preferred 20 meters. (Refer to Design Requirements)

j) Detail of survey benchmark (i.e., for trial pit & construction, for HDD DUSUP post pull x-y-z survey) shall be provided in the drawing.

k) Trenchless Specialist Contractors shall show evidence of "qualification" i.e., a copy of valid RTA approval to carryout proposed Trenchless crossing works in Emirates of Dubai.

l) All Trenchless crossing (HDD, PJ, TB, and MT) works must be carried out by the certified Operator under the qualified Supervisor. Project consultant or Client representative must confirm the verification of qualification of Machine Operator and Supervisor. A copy of Project consultant or Client representative's confirmation must be included in the Construction NOC submission.

m) Main Contractor and Trenchless Contractor quality management system and Contingency plan in case of equipment failure must be included in submission.

n) Contractor shall complete the trenchless crossing checklist and upload the completed checklist in e-NOC in order that field staff can verify the details at site (see Attachment 9A & B).

6.6 General Design Requirements - Open Cut Crossings

While trenchless method is preferred for utility crossing of DUSUP corridor, crossing below existing pipeline(s) and corridor by open cut excavation may be permitted under special circumstances after justification by the applicant and detail review of method statement and risk assessed and residual risk is reduced to ALARP.

DUSUP future pipelines at the existing major roads (ROW) are constructed by trenchless method, therefore crossing of other utilities above existing pipelines via open cut crossing method is typically permitted within the corridor intersection area in order that future pipeline crossing depth can be limited.

To avoid having the HC pipeline in between other utilities, all utilities within the crossing location shall cross the existing pipeline either above or below. Compliance to this requirement must be verified during the design stage. Any deviation to this requirement such as drainage line of gravity flow design may be accepted provided the proposed crossing design ensure that DUSUP/DPE operation and maintenance of existing pipeline and construction of future pipeline are not restricted.

General design requirements for open cut crossings are as follows:

a) Safety in design should be paramount, with due consideration of safe methods for the construction of the works and the ability to apply adequate controls for these activities. The design documents must consider the requirements outlined within this document along with any other controls that may be required by DUSUP.

b) The consultant must verify site conditions that could affect the safety and practicability of construction or operation in the presence of existing or planned DUSUP facilities (particularly above ground pipelines or valve station in the proximity of construction).

c) Utilities shall cross the DUSUP fenced corridor at an angle of 90º or as close to 90º as practicable. At DUSUP-RTA ROW interchange, angle may follow the ROW route to allow for future expansion of the road however this shall be reviewed by the DUSUP NOC Engineer.

d) At DUSUP-RTA ROW interchange, the utility crossing may change angle and direction within DUSUP corridor limits, on the basis it follows the RTA ROW route. However, at no point shall the utility run parallel to the DUSUP Pipelines within the DUSUP corridor limit.

e) For the crossing of utility below existing pipeline by open cut method, a minimum vertical separation of one (1.0) meter or minimum separation requirement of the owner of proposed utility; whichever is greater must be maintained between the bottom of lowest HC pipeline and the top of the proposed utility or sleeve. This clearance elevation must be maintained across the entire width of the DUSUP pipeline corridor to avoid any conflict with future pipeline construction and maintenance of pipeline.

f) For the crossing of utility above existing pipeline by open cut method, a minimum vertical separation of one (1.0) meter or minimum separation requirement of the owner of proposed utility; whichever is greater must be maintained between the topmost HC pipeline and bottom of the proposed utility or sleeve. This clearance elevation must be maintained across the entire width of the DUSUP pipeline corridor to avoid any conflict with future pipeline construction and maintenance of pipeline.

g) For the utility crossing by open cut method, a reinforced concrete slab 150mm thick shall be provided between the proposed crossing and existing DUSUP pipeline. The slab shall be pre-cast concrete, reinforced with A393 welded mesh and coated with minimum two coats of approved bituminous coating. Alternatively, the concrete protection slab(s) may be provided in smaller sections of 500mm x 500mm x 50mm thick - these slabs shall be fiber reinforced concrete and shall be layered such that total 150mm thickness is achieved. Either slab option shall be a minimum 600mm wider than the size of the HC pipeline diameter, and the slabs shall extend minimum 1.0 m from edge of utility / pipeline crossing (Refer to standard crossing detail drawings mentioned in design requirements item 6.6.1.)

h) If a protection berm is to be constructed over the proposed utility crossing or ground level is to be raised over the proposed utility, any impact on the existing or proposed DUSUP access between the corridor gate and road to be assessed and mitigated to DUSUP approval. Sand/soil berm over the proposed utility crossing of DUSUP corridor must be covered with suitable erosion protection material to avoid hazardous condition resulting from the erosion of berm and utility damage.

i) The cable shall be sleeved in heavy wall PVC or HDPE pipe, extending a minimum of 6 meters either side of the pipeline or full width of corridor, whichever is greater. Sleeve joints may not occur directly above or below the pipeline. Protection of cable(s) may include cable duct bank with or without concrete surround.

j) Proposed water / drainage main line crossing of DUSUP corridor /pipeline must be adequately designed and protected to ensure that no additional permanent protection to water/drainage line will be required during the operation and maintenance of existing HC

pipelines and construction of future HC pipeline. The future HC pipeline may be constructed at the same level of lowest pipeline in the corridor or minimum 3.0m below existing grade (to bottom of pipeline), whichever is lower, and minimum 1.0-meter unrestricted maintenance space is required 360° of existing HC pipeline.

k) Protection of water/drainage main at the DUSUP corridor/HC pipeline crossing may include but not limited to; provision of protection slab over the crossing water/drainage line, housing within the heavy-duty carbon steel sleeves, specialist designed concrete surround/grouted sleeve or HDPE pipeline (if by open cut); extending minimum 6 meters on both sides of DUSUP pipelines or the full length of corridor, whichever is greater.

l) Joints (collars) in the water or drainage secondary line shall be spaced at least 3 meters from the pipeline.

m) Manholes/shaft, bends, thrust block or any type of structure other than proposed water pipeline/drainage line are not permitted within the DUSUP corridor limit. However, manhole or foundations up to maximum 1.5m depth outside the “NOC No Go Zone” may be permitted within the ROW crossing of DUSUP corridor.

n) In desert areas, where existing ground elevation varies considerably across the width of corridor, the top of the proposed crossing shall be minimum 1.0m below existing pipeline or 4.5m below existing grade; whichever is greater. Such proposal shall be verified and assessed as per the actual site condition before approval.

o) In desert areas, back filling around the HC pipeline must be with clean “sifted” dune sand of low chloride content, compacted to at least original density by hand. In other areas, a Minimum 300mm around the existing pipeline shall be backfilled with dune sand or clean sand of low chloride content (less than 0.05 percent) mixed with sufficient water and manually compacted to minimum 90% of relative density for non-traffic areas. Minimum 95% of relative density of compaction must be achieved at the traffic area.

p) Excavated material may be reused for backfill over and above 300mm sand cover, provided the back material is free of large stone (i.e., less than 3” or half the size of backfill layer whichever is less) all organic material, debris or other deleterious material. Maximum thickness of manual backfill layer shall be limited to 150mm (0’-6”).

q) Utility owner’s standard underground utility crossing signs must be installed at either side of the crossing and at the edge of the pipeline corridor to assist future identification of the crossing.

r) For the crossing of gravity flow drainage lines, DUSUP corridor crossing design must be based on the (trial pit) verified elevation of existing DUSUP pipeline.

s) For laying proposed utility crossing below existing pipeline by open cut method, adequate support and protection must be provided to the existing pipeline(s) to the approval of DUSUP. The pipeline should not be left unsupported at any time including during installation of temporary or permanent support mechanisms. The maximum allowed span for pipeline supports for DUSUP/DPE pipelines is 10 m, taking into account the following:

i. For pipeline with significant wall loss defects, detailed stress analysis shall be undertaken by DUSUP/DPE to establish permissible unsupported lengths
ii. When planned excavations will exceed or are to be extended close to or beyond the 10 m limit, pipe support requirements shall be assessed and agreed with the DUSUP. 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.
iii. 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.
iv. Upon completion of the backfill activity, the depth of cover above the gas pipeline should be same as the depth of cover prior to the original excavation activity or more and in compliance with DUSUP approved berm specification.

t) A separate Trial Pit NOC request with a plan drawing and proposed location of trial pits must be submitted for DUSUP approval prior to commencement of any trial pit work.

u) For cable crossing above or below the existing HC pipeline by open cut method, utility owner approved cable identification marker tape must be provided above the cable.

v) No cable joint bay shall be located within the DUSUP corridor.

w) At HC pipeline crossings, a 12-meter length of prefabricated pipeline (new HC pipeline) shall be placed under the existing pipeline so that the tie-in welds will be made at least 6-meters from the existing live pipeline (from center line). The Contractor shall carry out a mandatory lower flammability limit gas test prior to and during any welding procedure.

x) For new HC pipeline crossing of existing HC pipeline, a 150mm thick precast concrete slab, reinforced with mesh reinforcement shall be installed between the new and existing pipeline and slab shall be coated with minimum two coats of approved bitumen emulsion paint. Concrete slab can be in smaller sections to assist easy handling as detailed in DUSUP Standard drawing: 900-08-062 (Attachment 5).

y) For pipelines to pipeline or pipeline to utility sleeve crossings, specific approval is required for the installation of one CP test post that commonly bonds across them. For pipelines running in parallel, standard independent test posts shall be utilised for each pipeline, and cross bonding to one standard test post shall not be utilised. The CP connection must be carried out by pin brazing or other DUSUP approved method. A third party company hired by the contractor or operator of the proposed pipeline will supply the pin brazing procedure to DUSUP for review and approval. The procedure must include ultrasonic wall thickness checks prior to pin brazing and coating thickness/integrity checks after pin brazing and coating repair of the DUSUP/DPE pipeline. CP test post installation on any DUSUP live hydrocarbon pipeline must be carried out by cathodic protection contractor approved by DUSUP.

z) Due care and diligence is required throughout the work to ensure no damage occurs to the existing pipeline/pipeline assets and pipeline coating. If any such damage occurs, the Pipeline Representative shall be informed immediately and the pipeline and / or coating repaired to the DUSUP/DPE specifications at the Contractor's expense.

6.6.1 Standard Crossing Details Drawings

Refer to following standard crossing details drawings for utility crossings:

Attachment No.	Drawing Title	Drawing Number	Revision
1	Cable Crossing Above Existing Pipeline	900-08-057	1
2	Cable Crossing Below Existing Pipeline	900-08-058	1
3	Water/Drainage Line Crossing Above Existing Pipeline	900-08-060	1
4	Water/Drainage Line Crossing Below Existing Pipeline	900-08-061	1
5	Hydrocarbon Pipeline Crossing Below Existing Pipeline	900-08-062	1

6.7 General Construction NOC Requirements for Open Cut Crossings

A construction NOC is submitted after incorporating Concept Design NOC / Preliminary Design NOC conditions. A check list for Concept Design / Preliminary Design NOC conditions compliance must be included in the submission of Final Design NOC.

6.7.1 Construction NOC Conditions

a) The construction contractor shall comply with DUSUP Standard NOC Conditions and above-mentioned design requirements.

b) The construction contractor shall comply with Dubai Municipality safety regulation for excavation safety.

c) Gas test shall be performed by trained personal at the DUSUP pipeline crossing location for excavation exceeding 1.2m (4'-0"). Test to be conducted before employees / workers enter the trench and regularly thereafter.

d) Shoring, step cutting (benching) or sloping (battering) must be provided for the excavation deeper than 1.2 meters to eliminate the risk of cave-in or trench collapse or Shielding (Trench Box) may be provided where suitable.

e) For benching protection in excavation, if the soil type is not confirmed the soil must have a slope of 1 ½ horizontal to 1 vertical (34 degrees). Type of trench protection must be identified in TRA.

f) The trench deeper than 1.2 m (4 feet) must have a safe means for workers to get in and out of the trench. (E.g., stairway, ladder, ramps). Means of egress must be fixed

and secure and shall be within 7.6m (25 feet) of lateral travel. Ladders must extend a minimum of 0.9m (3 feet) above the landing.

g) Plastic spades must be used while excavating within 0.50 meters of existing hydrocarbon pipeline.

h) Spoil and debris must be placed at least 1.2 m (4 feet) away from the edge of the excavation.

i) Approved barriers must be provided at a minimum 1.0-meter distance from the zone of influence or angle of repose line of excavation and no vehicle or storing of excavated material are permitted between the barrier and the edge of excavation.

j) The methods of backfill and compaction shall be clearly described in method statement and shall be approved by DUSUP in advance.

k) DUSUP pipeline must be protected with approved temporary protection and pipeline must be supported with the approved temporary support within the limit of span mentioned in above Design Condition item 6.6 (s).

l) Immediately after exposing the pipeline and before backfilling, the pipeline must be inspected by the DUSUP pipeline representative for condition of coating and any damage to the coating. Pipeline Operations Superintendent or his delegate typically performs assessment of the coating condition and repairs should they be necessary during trial pit excavations and prior to proceeding with the backfilling. Condition of the pipeline on exposing and before backfilling shall be recorded with photographs.

m) Any damage to the coating shall be repaired by DUSUP approved contractor as per DPE/DUSUP procedure, at the contractors cost.

n) Existing pipeline berm must be restored to the original conditions.

o) DUSUP must be notified before pressure testing of proposed drainage / water pipeline crossing DUSUP pipeline.

p) Consultant or Client representative must inspect the proposed crossing of water /drainage line under/above the existing hydrocarbon pipelines at the entire width of DUSUP corridor and certify that the construction of crossing is satisfactorily completed as per the design and adequately protected in order that the presence of water/drainage line(s) will not in any way restrict the operation and maintenance of existing DUSUP pipeline(s) including construction of future hydrocarbon pipeline(s) crossing over the water /drainage line(s) without providing any additional protection to water/drainage line in future.

6.8 Trenchless Utility Crossings

Trenchless crossing, also known as NDRC, NDCM or NDC, is widely used for utility crossing under the HC pipeline/DUSUP corridor. The following are the commonly used Trenchless Crossing methods in Emirates of Dubai:

a) Pipe Jacking

Though the thrust boring and micro tunnelling are also advanced forms of Pipe Jacking methods, traditionally Pipe Jacking is referred to an early form of technique for installing underground utilities using powerful hydraulic jacks to push specially designed man entry size pipes through the ground behind an open-ended cutting shield and at the same time manual excavation is taking place within the shield. Monitoring of line & level is done using survey equipment.

The limitation of this method is that little control of the excavation face was possible and running ground especially below the water table could flow easily along the cutting shield and lead to large settlements. Therefore, this method is only recommended for crossing above water table.

b) Thrust Boring

Thrust boring is an improved version of Pipe Jacking, wherein crossing is done by combination of jacking and augur drilling, excavation is within the cutting shield and soil is transferred out of the casing pipe by a cased screw auger's blade.

c) Micro Tunnelling

Micro tunnelling is an advance form of Thrust Boring which uses highly sophisticated guidance system, remotely operated from the control room on the ground. Monitoring of line & level is by laser target system with fixed pipe jacking laser in the entry shaft and active laser target in the machine. Most machines also have video cameras set up to give more information. Slurry system is used to protect from over excavation and stabilizing the ground around drilling. Micro tunnelling cutting shield is watertight therefore suitable for drilling under water table.

For long micro tunnelling routes (i.e. > 200 m), Intermediate Jacking Stations (IJS) may require to be utilised. IJS shall be located 10m, horizontally, from the pipeline location. DUSUP may allow IJS to be located within 10m of a pipeline (but not within 5 m), on the basis that contractor provides appropriate risk assessment, detailing the potential for cavitation of the ground, and how ground settlement and disturbance will be minimised.

d) Horizontal Directional Drilling

Horizontal Directional Boring, commonly called as HDD, is a steerable trenchless method of installing underground pipes, conduits, and cables in a shallow arc along a prescribed bore path by using a surface launched drilling rig, with minimal impact on the surrounding area. However, drill route needs to be shallow, curved along a prescribed bore path before it reaches its intended grade or elevation. The method comprises a three-stage process:

- Drill a pilot hole on the designed path.
- Enlarges the hole by passing a larger cutting tool known as the back reamer.
- Pull the product or casing pipe in the enlarged hole.

Further details on differing HDD tracking tools is provided in Attachment 11.

6.8.1 Specific Design Requirements for Trenchless Crossing

When crossing existing infrastructure such as HC pipelines, other utilities, and road etc., by trenchless crossing method, a lack of understanding of the geotechnical setting or improper

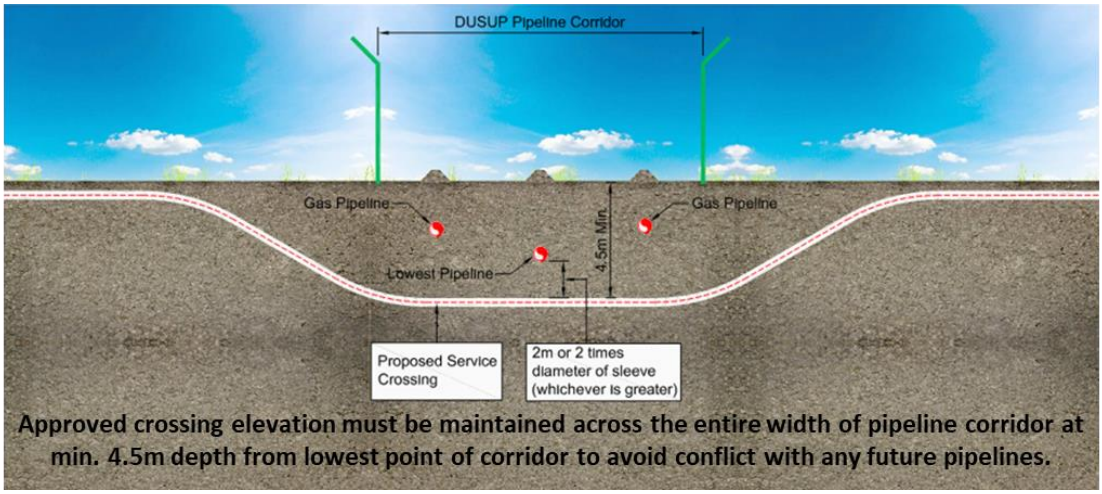
design of the path below surface could lead to excessive heave or surface settlement may cause damage to the existing infrastructure above. A significant risk of an improperly planned trenchless crossing is cross boring into the existing subsurface pipeline or utility.

a) Trenchless crossing risk management requires a thorough understanding of potential problems that are site specific to each crossing on a project. Appropriate risk mitigation measures can then be incorporated into the design and crossing details of the selected crossing method can be stipulated.

b) Geotechnical investigation must be carried out to determine the physical properties of soil and rock below surface including ground water table at each crossing location as per the RTA approved specialist NDRC consultant's recommendation and best industry practice. (Note: Detail design of Trenchless crossing may be carried out during the construction stage by the specialist trenchless crossing contractor to the approval of RTA approved Consultant).

c) Non-HDD trenchless crossing design must include detail of entry pit and exit pit including size & thickness of thrust wall and elevations and other corresponding information for verification at site.

d) For non-HDD trenchless crossings, the minimum vertical separation between the bottom of lowest hydrocarbon pipeline in the corridor and the top of crossing sleeve/utility must be 2.0 meters for crossing sleeves up to and including one (1.0) meter diameter and minimum of 2.0 times the sleeve diameter for trenchless crossing sleeve greater than one (1.0) meter diameter as shown in sketch below:.



This lowest clearance elevation must be maintained across the entire width of the DUSUP pipeline corridor to avoid any conflict with future pipeline construction and maintenance of pipelines. However, if the corridor ground elevation across the width of corridor has significant change or there is a steep slope within the corridor, above condition may not be suitable. Therefore in such cases, additional crossing requirement as applicable shall be followed:

- Trenchless crossing shall cross below the lowest pipeline with stipulated minimum vertical separation and cross the corridor at same level or lower, but

the crossing depth (to the top of utility crossing) shall not be shallower than 4.5m from the lowest ground level along the crossing route.

e) The minimum horizontal separation distances between the nearest edges of the launch and receive pit to the edge of the hydrocarbon pipeline(s) is 15 meters with a preferred separation of 20 meters. Further, entry and exit pits must be minimum 5 m away from DUSUP fence to reduce likelihood of fence damage and collapse, and both pits shall be located out with DUSUP Corridor.

f) Reduction in horizontal separation distance from the entry pit to existing pipeline is not recommended. However, where minimum 15-meter horizontal separation from the pipeline to the entry pit is not possible, separation distance may be reduced provided the design is carefully reviewed considering the safety of pipeline by an approved third-party specialist consultant at no cost to DUSUP/DPE. Specialist recommended reduction in separation distance shall be further risk assessed and accepted only after hazard affect is mitigated to reach ALARP.

g) The design and selection of trenchless crossing by HDD method must consider the existing interferences in the crossing route.

h) Wireline and Gyro HDD - Cross Bore risk in HDD may be reduced by using a Wireline Locating System with closed loop such as AC AMF (Paratrack-2) or a Gyro Compass/Gyro Steering System with minimum (clear) vertical separation of 5.0M from the maximum reamer size to the bottom of lowest pipeline.

Or

Reducing the risk associated with Cross Boring via HDD crossing can be achieved by implementing “Observation pit” where cross boring is expected. The observation pit must be dug up to the depth of minimum 1.0m below bottom of the HC pipeline being crossed and extended by 2.0m on either side of drilling route. The Observation pit must be available during both pilot bore and reaming activities such that DUSUP Pipeline Representative can witness (take photographs) of safe passage of both pilot and all reaming activities under the pipeline/s. With observations pits provided, the separation distances between DUSUP Pipeline and the Bore can be reduced – Refer to 6.8.1(k) and (l) for details.

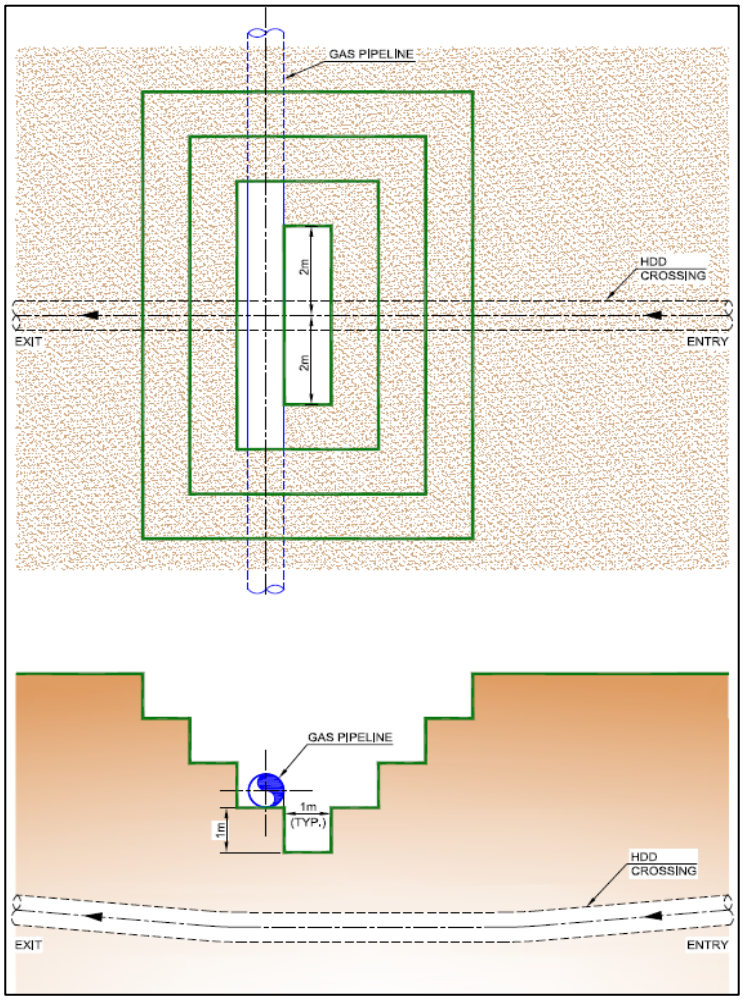


Figure 1 Observation Pit

i) Where excavation of Observation pit is not feasible (e.g., due to hard soil or proximity to road etc.,) a sheet pile or steel sheet barrier may be driven at 5.0m distance from the HC pipeline to the depth up to 1.5m below the bottom of pipeline and extended minimum 2.0m on either side drilling route. Vibration for the installation of sheet file shall be monitored to ensure that particle velocity remain below 40mm/sec.

j) If an excavation of Observation pit to the full depth (1 m below pipeline) is not feasible (e.g.: due to the presence of high-water table), a partial observation with sheet piling can also be implemented as shown on sketch below:

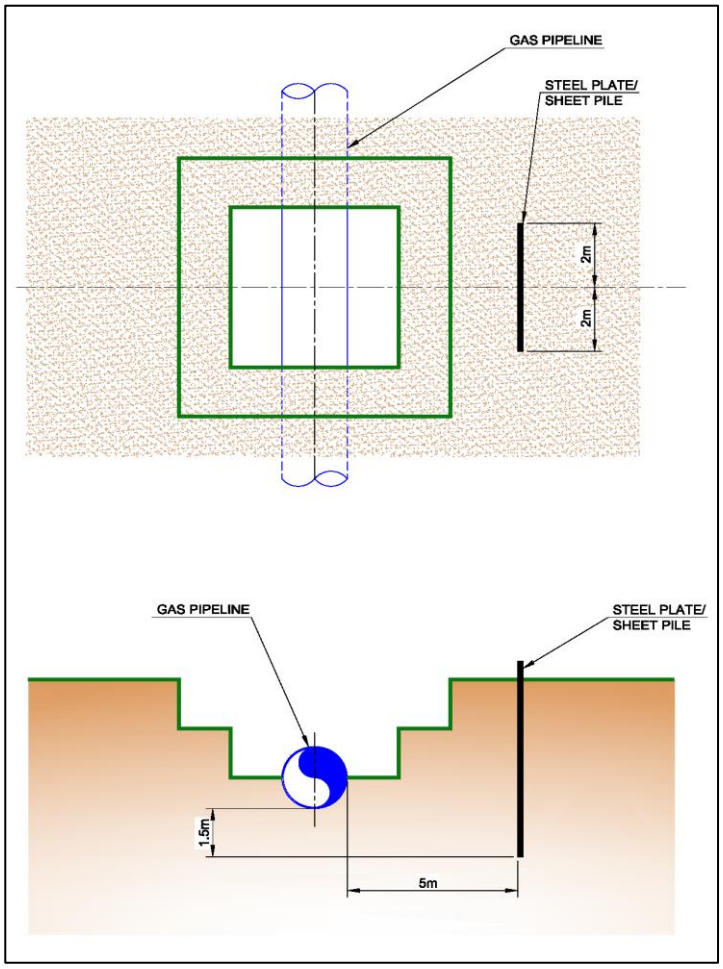


Figure 2 Observation Pit with Sheet Pile

k) With observation pits, Wireline and Gyro HDD crossing design for bore/drill under the existing HC pipeline must have minimum clear vertical separation of 2.0m from maximum reamer size to the bottom of the Hydrocarbon Pipeline (up to maximum reamer size of 1.0m), or 2 times the diameter of maximum reamer size, or as recommended by the HDD specialist; whichever is greater.

l) Walkover HDD Crossings **require** an Observation Pit (regardless of proposed vertical separation distances) and design for bore/drill under the existing HC pipeline must have minimum clear vertical separation of 2.0m from maximum reamer size to the bottom of the Hydrocarbon Pipeline (up to maximum reamer size of 1.0m), or 2 times the diameter of maximum reamer size, or as recommended by the HDD specialist; whichever is greater.

m) New underground crossing utility marker signs must be installed either side of the pipeline crossing and at corridor limits to assist future identification of the crossing after the completion of works.

n) Trenchless utility crossing of pipelines under a road intersection are not permitted unless the depth of the pipeline can be verified at the exact crossing location, via trial pit. Trial pits either side of the road to estimate the pipeline depth directly under the road, are not acceptable, due to potential changes of pipeline depth as the pipeline traverses the road.

o) Utilities shall cross the DUSUP fenced corridor at an angle of 90 ºor as close to 90º as practicable. At DUSUP-RTA ROW interchange, angle may follow the ROW route to allow for future expansion of the road however this shall be reviewed by the DUSUP NOC Engineer.

p) For trenchless crossing of DUSUP RTA ROW or DUSUP fenced corridor, the angle and direction of the crossing shall not change within DUSUP corridor limits.

q) For all HDD types, the distance between the drill rod end and the probe sensor shall be taken into account when finalising the profile of the HDD, and included in the method statement.

6.8.2 Specific Trenchless Crossing Construction NOC Conditions

a) Trenchless crossing (HDD & PJ, TB, and MT) works must be carried out by the certified Operator under the qualified Supervisor. Project consultant or Client representative must confirm the verification of qualification of Machine Operator and Supervisor. A copy of Project consultant or Client representative's confirmation must be available at site for the DUSUP site representative verification before commencement of the work.

b) Refer to Trenchless Non-HDD and HDD Crossing NOC review Check list (Attachment 9A & B), approved operator's details shall be included in the checklist and completed checklist shall be uploaded in e-NOC by the DUSUP NOC processor.

c) The supervisor and trenchless crossing equipment operator must attend DUSUP Pipeline Safety Training and carry valid Pipeline Safety Supervisor card from DUSUP during the work.

d) A copy of maintenance history of equipment (not older than 6 months old) verified by the project consultant or client's representative shall be available on site for DUSUP representative checking.

e) The specialist non-HDD trenchless crossing contractor must inspect and certify the preparation of the drive pit and receiving pit and a copy of the specialist signed inspection document must be provided to the DUSUP site representative before commencement of the work.

f) Before commencement of the non-HDD crossing works, blinding, top elevations, railing top elevations and alignment monitoring system for PJ & TB or laser guidance system axis elevation for MT must be verified to ensure that the crossing levels matches with the approved drawing and the elevations checked must be recorded in the presence of DUSUP representative and a copy of the verified document must be submitted along with the as built submission. Attachment 10A shall also be filled in in the presence of the DUSUP Pipeline Representative prior to starting the work.

g) Elevation ground surface along the drilling route must be recorded before and after the drilling operation and a copy of elevation check must be submitted to DUSUP for record.

h) Any settlement of ground that occurs due to the proposed trenchless crossing works must be repaired / rectified to the satisfaction of DUSUP at no cost to DUSUP.

i) Any stoppages or abnormality found during the trenchless crossing must be brought to the notice of DUSUP site representative and must be recorded in the trenchless crossing log. Abnormality such as ground settlement during the crossing work and disproportionate soil recovery may require further assessment before proceeding with work.

j) The drive and receiving pits for crossing work shall be located outside the corridor, but to ensure the safety of personnel working within the drive and receiving pits, the works within the drive and receiving pits must be covered under the project safety / permit system.

k) Drive pit and receiving pit must be adequately barricaded with approved safety barriers with “deep excavation” warning and barricade flashing safety lights.

l) The proposed trenchless crossing alignment must be maintained as per the approved drawing and any changes or deviation of works from the submitted drawings will require review and separate approval from DUSUP.

m) Within 10.0 (ten) days of completion of the crossing works, contractor shall submit a post construction report along with a copy of drilling log and details of any problems encountered during the crossing activities and the measures that were taken to solve or mitigate any problems.

Note: As per standard RTA e-NOC requirement for NDRC works, all proposed trenchless crossing of HC pipelines must be supervised by RTA approved NDRC consultant.

6.8.3 Additional Specific NOC Construction Conditions for HDD Crossing

a) Pipeline Representative shall complete HDD checklists with contractor’s supervisor (Refer to Attachments 10B &C)

b) Approved HDD route must be marked on the ground before commencement of drilling and shall be staked at the pipeline crossing location and at each drill rod intervals as shown on approved profile drawings to record the depth and elevations for logging in drill log and as built record.

c) The existing ground / berm surface elevations at the proposed crossing locations 5.0 (five) meters either side of the crossings, each drill rod intervals and at the limits of DUSUP pipeline corridor along the HDD route must be recorded before commencement of drilling the presence of DUSUP site representative. Any changes in elevation of ground must be informed to the DUSUP site representative and the approved minimum vertical separation from the drill profile to the existing pipelines must be maintained.

d) Whenever possible HDD should be planned such that back reaming and pulling the pipe / conduit is completed on the same day. If necessary, it is permissible to drill the pilot hole and pre-ream one day and complete both the final ream and the pullback on the following day.

e) The contractor shall provide a forecast and report to DUSUP including planned activities for next 2 (two) days, daily reports and logs of all HDD activities undertaken.

f) Prior to the commencement of reaming activities, the contractor must furnish an as built plan and profile of the actual pilot drill crossing to confirm that the installation is in compliance with approved bore path drawings. Pilot hole alignment shall require DUSUP representatives' acceptance prior to reaming and pipe/conduit installation.

g) The operator must perform HDD operations under the constant direction of a drilling supervisor who shall remain on site and be the responsible person in charge throughout the drilling operation.

h) HDD operator must have a clear line of sight between the entry and exit points.

i) HDD entry and exit points shall not deviate from the approved drawing, nor shall the drill path deviate from the staked bore path centreline. Any HDD installation that deviates from an approved path may be rejected by DUSUP without any liability and cost to DUSUP.

j) Reasonable limits shall be placed on maximum fluid pressures in the annular space of the bore to prevent inadvertent drilling fluid returns to the ground surface, particularly at the observation pit(s).

k) If the contractor must abandon the drill hole before completion of the crossing, the contractor shall seal the borehole with neat cement grout starting at the low point or end of the drill hole.

l) Drilling fluids / cuttings that may by means of hydraulic fracture (hydro-frac or frac-out) collect into the observation pit(s) shall be removed and disposed of immediately such that the safe passage of both pilot and reaming activities can be continuously witnessed.

m) Witnessed as-built drilling profile information must be marked on approved profile drawing in the presence of DUSUP pipeline representative and a copy of same must be submitted to DUSUP pipeline representative at site for verification of as-built submission during NOC Closeout.

n) The drill string shall be pulled back to the drill rig anytime the ability to steer / track is lost, including when the Walkover transmitter batteries fail, or the drill string breaks.

o) While drilling, the bore hole assembly (BHA) shall be tracked at least every full length of drill rod, more frequently depending on existing underground infrastructure congestion in the area. Each tracking location shall be marked, and progress checked to ensure the bore is maintaining the approved / design bore path.

p) Depth, pitch / inclination, and roll / azimuth readings of the BHA shall be taken after drilling every single joint; such readings being required to calculate the horizontal and vertical coordinates of the BHA as it progresses.

q) Should any corrections be made to remain on the design drill path then such shall also be recorded on the Locating / Steering Record Pro-forma

r) Drilling operations shall cease if an unidentifiable, abnormal, or unanticipated resistance or sudden movement of the drill string is encountered. Further, if other conditions develop (lightning, etc.) that could affect the safe operation of the equipment and personnel,

drilling operations shall cease. Works may resume only after the source of the disturbance has been identified and / or eliminated.

s) Following completion of a HDD near an existing hydrocarbon pipeline, if any abnormality found in the observation pit, DUSUP may require the contractor expose the pipeline(s) and perform a coating defect survey and or a leak survey.

t) The contractor must assist DUSUP to carry out a post-pulled conduit and pipe installation (x-y-z) survey of as built using gyroscope mapping tool, which includes contractor's assistance in providing accurate survey (x-y-z) tool entry and exit coordinates and elevations.

u) The contractor shall allow any DUSUP or DUSUP appointed representative(s) to perform inspection on contractors QA/QC program and drilling operations related to the proposed HDD works.

6.9 General Design Requirements - OHL Crossing

a) The design of the minimum vertical clearance at the crossing of DUSUP corridor /pipeline route must allow for unrestricted passage of regular DUSUP patrol and operation of maintenance equipment/excavation plant up to 5.5-meter high under the OHL crossing.

b) For minimum vertical and horizontal clearances refer to DUSUP drawing reference 900-08-059 (Attachment- 6).

c) No OHL support poles of any type (e.g., wood, concrete, or metal) are permitted within the corridor or within the minimum separation distance from the pipeline as mentioned in DUSUP Standard drawing 900-08-059 (Attachment- 6).

d) To mitigate AC interference from high voltage power cable, where possible cable shall cross DUSUP/DPE's HC pipeline at an angle of 90 degrees or as close to 90 degrees as practicable.

e) An interference study of the H.V. Cables on existing pipeline(s) must be conducted by the initiating party to determine the possible impact on the existing hydrocarbon pipelines. Study shall include crossing of corridor/pipeline and parallel installation within DUSUP NOC Zone (i.e., 300m from the existing HC pipeline or corridor for parallel OHL Installation). As a minimum the study should consider the following.
   - Danger to people who come in direct contact or contact through conductive parts with the metallic pipeline or the connected equipment
   - Damage of the pipeline or to the connected equipment; (i.e., AC corrosion)
   - Disturbance of electrical/electronic equipment connected to the pipeline.

f) A report supported with calculations, proving that any electrical induced effects / issues related to the existing pipeline(s) have been satisfactorily considered, together with detail of any actions necessary to mitigate the effects must be submitted for DUSUP review. The report shall consider all aspects of electrical conditions on the pipeline (coating, CP, insulating joints, etc.), safety of the public, DUSUP personnel, and include sections (as a minimum) as follows:
   - Effect of "steady state" condition.

- Effect of switching and/or other transient conditions with the frequency and duration.
- Effect of peak load conditions with the frequency and duration.
- Effect of extreme load (phase) imbalance, or phase to earth faults with the frequency and duration.
- Influence of earthing system in that it shall not load or de-stabilize the pipeline CP system.

Note: Internationally accepted codes / practices for performing these calculations can be advised upon request

g) The design and installation of the OHL shall ensure that the levels of AC voltage do not cause AC corrosion on DUSUP pipeline. Corrosion likelihood may be negligible if alternating current density referred to a 1 cm^2 bare surface (e.g., an external test coupon/probe) is lower than 30 A/m^2. If current density is greater than 30 A/m^2, monitoring/mitigation measures should be installed to limit the impact of AC corrosion.

h) With respect to personnel safety, the design and installation of the OHL shall ensure that the AC touch voltage on the pipeline is kept below 15V.

i) The calculation or mathematical modelling provided within the report shall be conservatively based, transparent and detail as a minimum the following:
- Parallel length & separation distance of cable to pipeline/crossing angle to pipeline.
- Fault current.
- Location and design of earthing points.
- Cable specification.
- Soil Resistivity
- the current flowing in the AC power line
- the configuration of AC power line phase conductors
- the voltage the AC power line system

j) DUSUP reserve the right to have an independent expert review of any submission for completeness & accuracy.

k) Earthing roads shall be kept a minimum of 10 m away from a ICCP protected pipelines to prevent any interference.

6.9.1 Construction NOC Requirements – OHL Crossings

a) Approved AC mitigation measures must be implemented before commissioning of the OHL at contractor's cost and to the satisfaction of DUSUP.

b) AC mitigation works may require separate hot work permit from DUSUP. The contractor must ensure that DUSUP trained Permit holder is available for the execution of work.

c) Installation of approved monitoring/mitigation measures shall be verified and tested at site to confirm and/or determine any extent of AC influence on the pipeline once the electrical cabling has been installed. This may include the following:
- Field verification of test procedure used.
- Electrical measurement of induced AC potentials between the pipeline and ground.

- Electrical measurement of induced AC current on the pipeline. Note that the current density can only be accurately estimated by means of installed coupons or probes.
- Calculation of the potentials and currents to which the pipeline may be subjected under steady state and fault conditions.

d) Permanent warning boards indicating the presence of overhead transmission lines and their height must be installed on the corridor at either side of the crossing at 20 meters or as approved by DUSUP.

7 CATHODIC PROTECTION TEST POST FOR UTILITY CROSSING

The following Utility crossings require appropriate CP Test Posts at the discretion of the DUSUP Operations Pipeline Superintendent:

a) OHL Crossings
b) Cable Crossings
c) Steel Pipeline including any steel casings

The above shall be detailed to DUSUP Pipeline Operations Engineer for review.

The CP requirements for Railway and Road Crossings are detailed in DUSUP Guidelines for Road and Rail Infrastructure Crossing DP-OPSON-0152.

8 UTILITIES PARALLEL TO DUSUP PIPELINE/CORRIDOR

a) Typically, no utilities other than HC pipelines are permitted within 10 meters of existing HC pipelines. However, other utility corridor may exist within 10 meters of parallel distance from the existing HC pipeline/DUSUP corridor and “DUSUP No Go Zone”; in such cases design and construction of other utilities require specific technical review and shall be risk assessed and accepted only after hazard affect is mitigated to reach ALARP.

b) Existing DUSUP corridor fence in the proximity of proposed utility must be protected during the construction to the satisfaction of DUSUP. Any damage to the existing fence must be rectified or replaced as per DUSUP standard fence drawing.

9 DUSUP NOC CLOSEOUT

All NOC issued for the work within DUSUP corridor, “No Go Zone” and Utilities constructed proximity of DUSUP corridor limit/fence must be formally closed as described in DUSUP NOC Standard Conditions.

Any intrusive work such as Trial Pit on existing HC pipeline, excavation parallel to and within 5.0M of DUSUP corridor fence or property shall be field verified by Pipeline Representative during the execution of work and at the completion such work, to ensure that necessary reinstatement work is completed as specified in NOC and no damage incurred to DUSUP property from the work.

For DUSUP NOC Close-Out Requirements refer to:

DUSUP NOC Standard Conditions - DP-OPSON-0056

10 UTILITY EMERGENCY WORK IN THE VICINITY OF DUSUP PIPELINES

Currently, there is no common bridging procedure for the commencement of emergency works between all utility owners in Dubai.

However as stated in Article (4) of: Regulation No. (4) of 2009 - Concerning the Regulation of Work in the Right of Way in the Emirate of Dubai:

"Notwithstanding the provisions of Article (3) of this Regulation, the Competent Entities may, in cases of emergency, carry out works in the Right of Way or create Traffic Diversions before obtaining a No Objection Certificate, provided that the Agency is notified immediately upon the commencement of such works, and the No Objection Certificate is applied for within a maximum period of twenty-four (24) hours from the commencement of such works."

Emergency works within the DUSUP NOC zone can be commenced before obtaining an NOC; provided the work is carried out as per the utility owner approved emergency / safe work procedure(s) and by immediately notifying RTA, DUSUP and all other affected parties using their respective emergency contact numbers.

Formal NOC request must be submitted within twenty-four (24) hours from the commencement of such works.

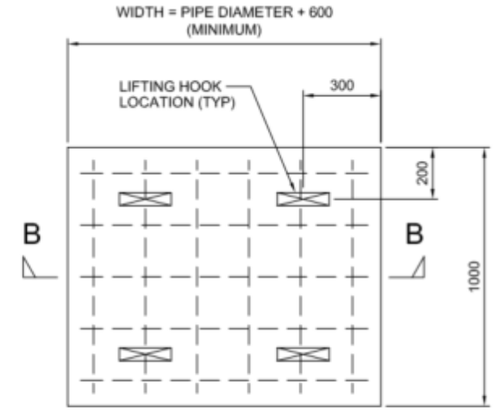
Utility owner's emergency team / delegate shall call DUSUP Control room on telephone number: 04-802 8720 / 050-910 4642; provide emergency work location and wait for DUSUP / Pipeline owners' representative to arrive at site prior to excavation. Should the emergency work be conducted outside the DUSUP fence but within the corridor, the contractor may start the emergency work without the presence of the Pipeline Representative on the basis that the work is conducted 10m away from a pipeline and the ROW Control Room has been notified and has provided approval to commence. If located within the DUSUP fenced area or within 10m of a pipeline (out with fenced area), pipeline representative must be present prior to commencement of emergency work.

For DEWA Emergencies, DEWA contactor shall refer to DUSUP Guidelines for DEWA Work within Hydrocarbon Pipelines NOC Zone (DP-OPSON-0156).

11 DUSUP GUIDELINES

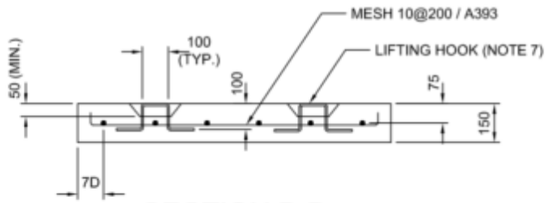
Various Guidelines for DUSUP/DPE Onshore pipelines are being developed for use. Reference can be made to the following link: https://dusup.ae/dusup-noc-guidelines/**.**

ATTACHMENT 1- CABLE CROSSING ABOVE



DETAIL 1 : IDENTIFICATION SLAB PLAN

SCALE=1:20

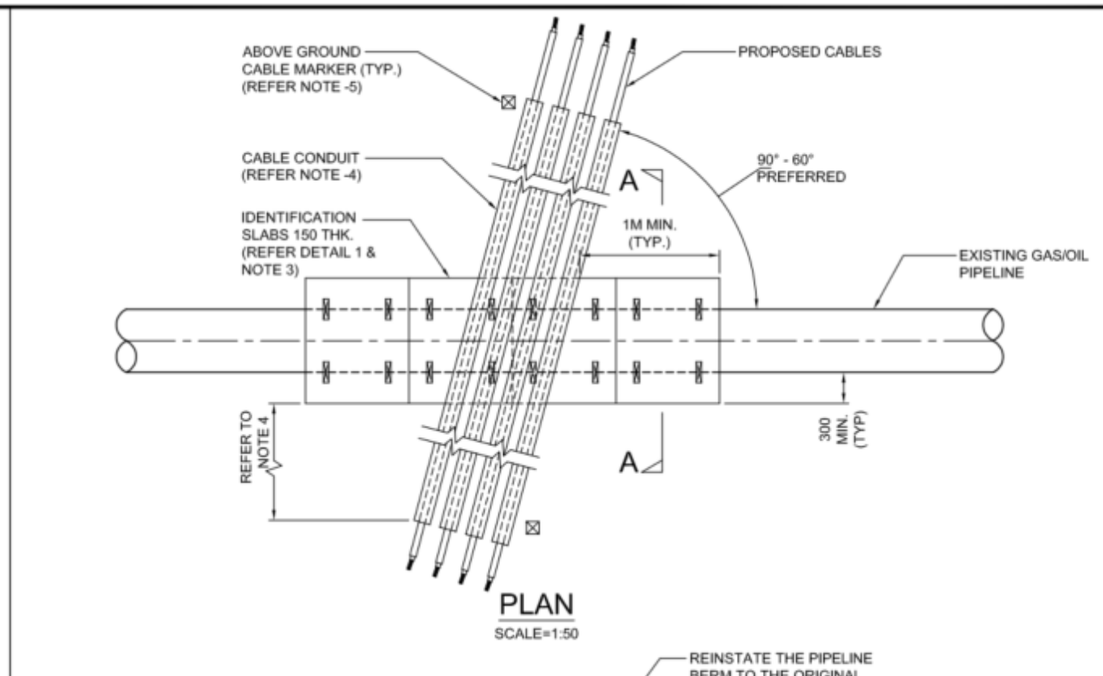


SECTION B-B

SCALE=1:20

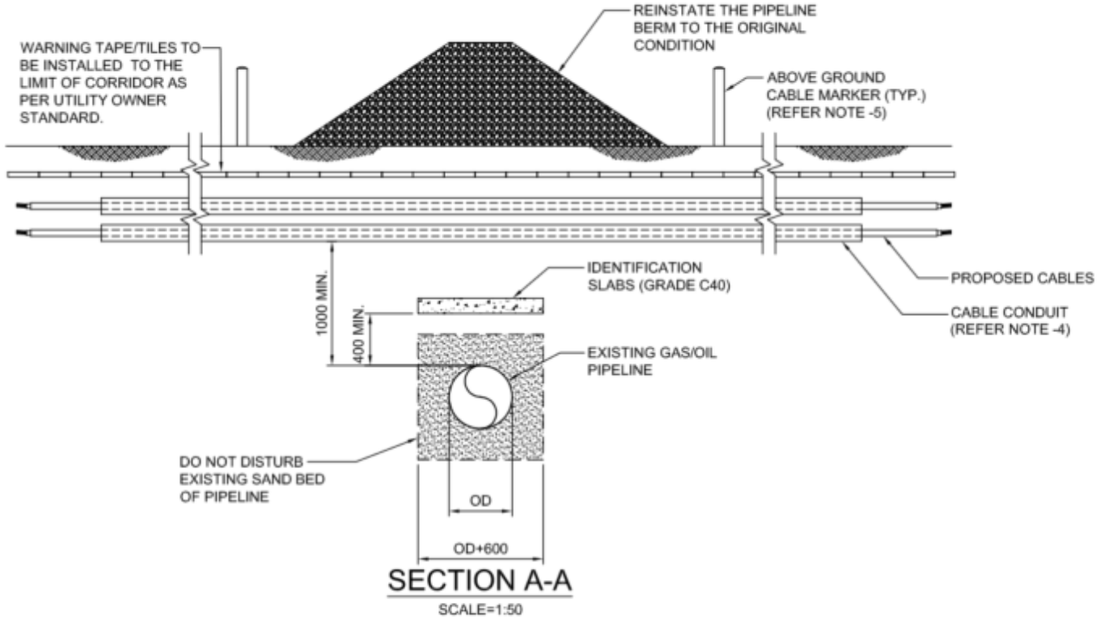
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
2. CABLE CROSSING ABOVE EXISTING GAS/OIL PIPELINE IS PERMITTED ONLY FOR CABLE LAYING WITHIN ROAD RIGHT OF WAY (ROW).
3. 150MM THICK PRE-CAST CONCRETE SLAB REINFORCED WITH A393 WELDED MESH AND COATED WITH MINIMUM TWO COATS OF APPROVED BITUMINOUS COATING, OR FIBER REINFORCED CONCRET SLABS IN SMALLER SECTIONS (I.E. 500MM X 500MM X 50M THICK) TO BE PROVIDED. THE 50 MM THICK FIBER REINFORCED CONCRETE SLABS SHALL BE LAYERED SUCH THAT 150MM OVERALL THICKNESS IS ACHIEVED. 50MM THICK SLABS SHALL BE STAGGERED TO AVOID ALIGNING OF JOINTS. SLAB SHALL HAVE "HIGH PRESSURE GAS/FUEL PIPELINE" INSCRIPTION ON TOP.
4. CABLE CONDUIT OR DUCT BANK (HDPE OR HEAVY DUTY PVC) EXTENDING A MINIMUM OF 6 METERS EITHER SIDE OF THE PIPELINE OR FULL WIDTH OF CORRIDOR, WHICHEVER IS GREATER.
5. UTILITY OWNER'S STANDARD UNDERGROUND UTILITY CROSSING SIGNS MUST BE INSTALLED AT EITHER SIDE OF THE CROSSING, AT ANY CHANGE OF DIRECTION WITHIN THE CORRIDOR AND AT THE EDGE OF THE PIPELINE CORRIDOR TO ASSIST FUTURE IDENTIFICATION OF THE CROSSING.
6. THE CONTRACTOR SHALL PREPARE SEPARATE JOB SPECIFIC SHOP DRAWING USING THIS STANDARD DETAILS FOR DUSUP APPROVAL.
7. 8MM DIA. GI LIFTING HOOK SHALL BE WRAPPED WITH DENSO TAPE AND COVERED WITH CEMENT MORTAR.



PLAN

SCALE=1:50



SECTION A-A

SCALE=1:50

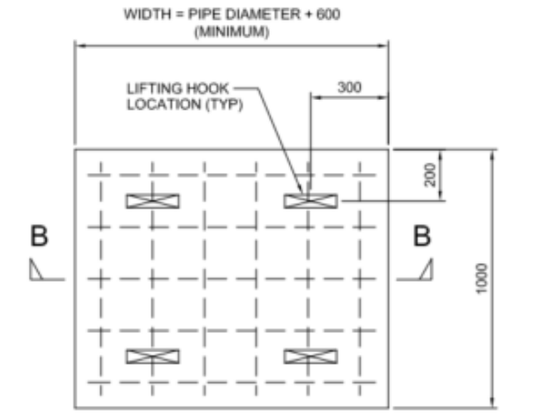
Rev.	Date	Revision Description	Drawn	Checked	Approved
1	03.02.2025	GENERAL REVISION	BV	SK	RRN
0	25.01.2022	First Issue	BV	RSK	RRN

Dubai Supply Authority

STANDARD DRAWING
CABLE CROSSING ABOVE EXISTING PIPELINE

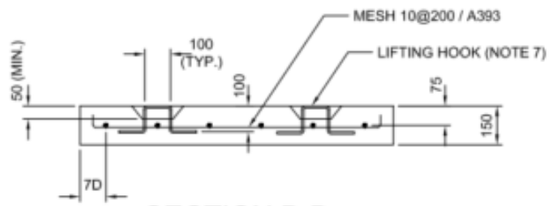
CAD File Name	Size	Scale	Area Code	Doc Code	Serial No.	Sheet of	Sheets	Rev. No.
900-08-057-001-R1 CABLE CROSSING ABOVE PL.DWG	A3	AS SHOWN	900	08	057	001	001	1

ATTACHMENT 2- CABLE CROSSING BELOW



DETAIL 1 : IDENTIFICATION SLAB PLAN

SCALE=1:20

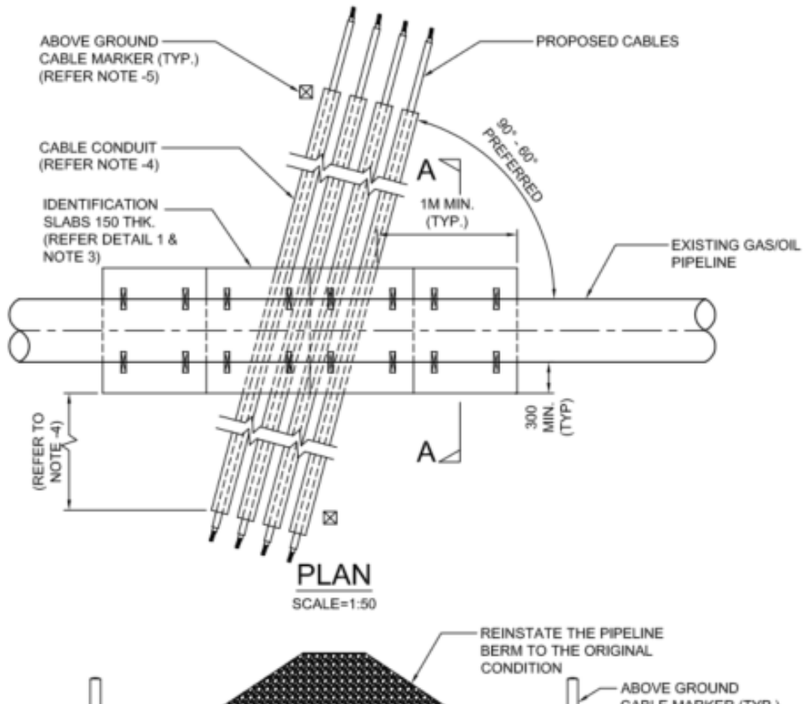


SECTION B-B

SCALE=1:20

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
2. MAXIMUM SUPPORT SPAN FOR EXPOSED PIPELINE IS 10M
3. 150MM THICK PRE-CAST CONCRETE SLAB REINFORCED WITH A393 WELDED MESH AND COATED WITH MINIMUM TWO COATS OF APPROVED BITUMINOUS COATING, OR FIBER REINFORCED CONCRETE SLABS IN SMALLER SECTIONS (I.E. 500MM X 500MM X 50M THICK) TO BE PROVIDED. THE 50 MM THICK FIBER REINFORCED CONCRETE SLABS SHALL BE LAYERED SUCH THAT 150MM OVERALL THICKNESS IS ACHIEVED. 50MM THICK SLABS SHALL BE STAGGERED TO AVOID ALIGNING OF JOINTS. SLAB SHALL HAVE "HIGH PRESSURE GAS/FUEL PIPELINE" INSCRIPTION ON TOP.
4. CABLE CONDUIT OR DUCT BANK (HDPE OR HEAVY DUTY PVC) EXTENDING A MINIMUM OF 6 METERS EITHER SIDE OF THE PIPELINE OR FULL WIDTH OF CORRIDOR, WHICHEVER IS GREATER.
5. UTILITY OWNER'S STANDARD UNDERGROUND UTILITY CROSSING SIGNS MUST BE INSTALLED AT EITHER SIDE OF THE CROSSING, AT ANY CHANGE OF DIRECTION WITHIN THE CORRIDOR AND AT THE EDGE OF THE PIPELINE CORRIDOR TO ASSIST FUTURE IDENTIFICATION OF THE CROSSING.
6. THE CONTRACTOR SHALL PREPARE SEPARATE JOB SPECIFIC SHOP DRAWING USING THIS STANDARD DETAILS FOR DUSUP APPROVAL.
7. 8MM DIA. GI LIFTING HOOK SHALL BE WRAPPED WITH DENSO TAPE AND COVERED WITH CEMENT MORTAR.



PLAN

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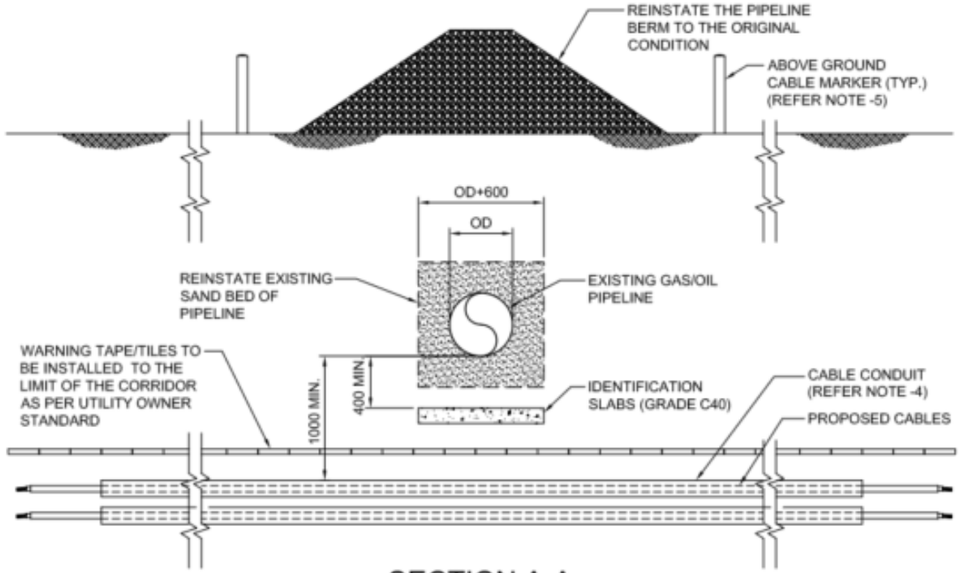


SECTION A-A

SCALE=1:50

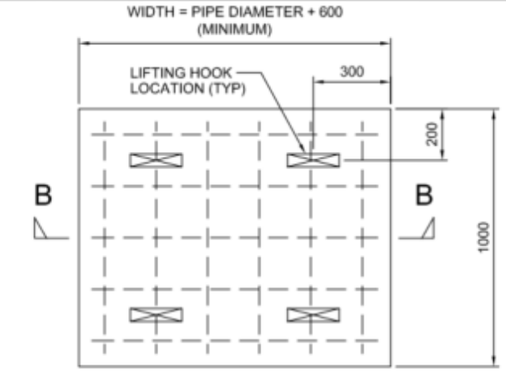
Rev.	Date	Revision Description	Drawn	Checked	Approved
1	03.02.2025	GENERAL REVISION	BV	SK	RRN
0	25.01.2022	First Issue	BV	RSK	RRN

Dubai Supply Authority

STANDARD DRAWING
CABLE CROSSING BELOW EXISTING PIPELINE
(OPEN CUT METHOD)

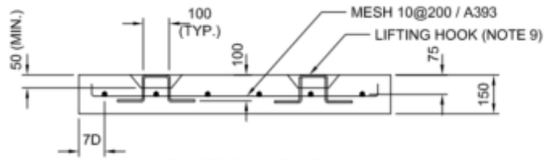
CAD File Name	Size	Scale	Area Code	Doc Code	Serial No.	Sheet of	Sheets	Rev. No.
900-08-058-001-R1 CABLE CROSSING BELOW PL.DWG	A3	AS SHOWN	900	08	058	001	001	1

ATTACHMENT 3 - WATER/DRAINAGE LINE CROSSING ABOVE



DETAIL 1 : IDENTIFICATION SLAB PLAN

SCALE=1:20

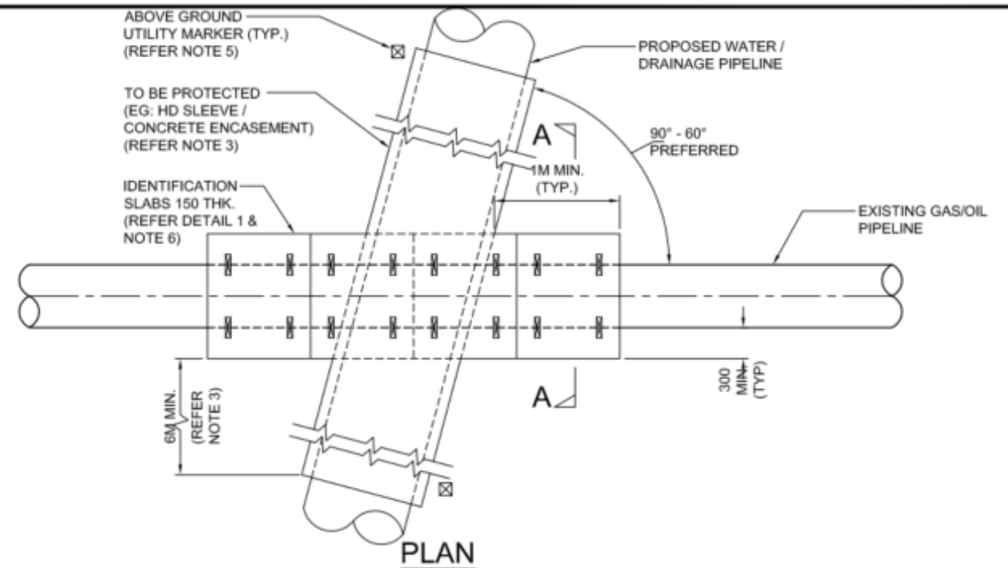


SECTION B-B

SCALE=1:20

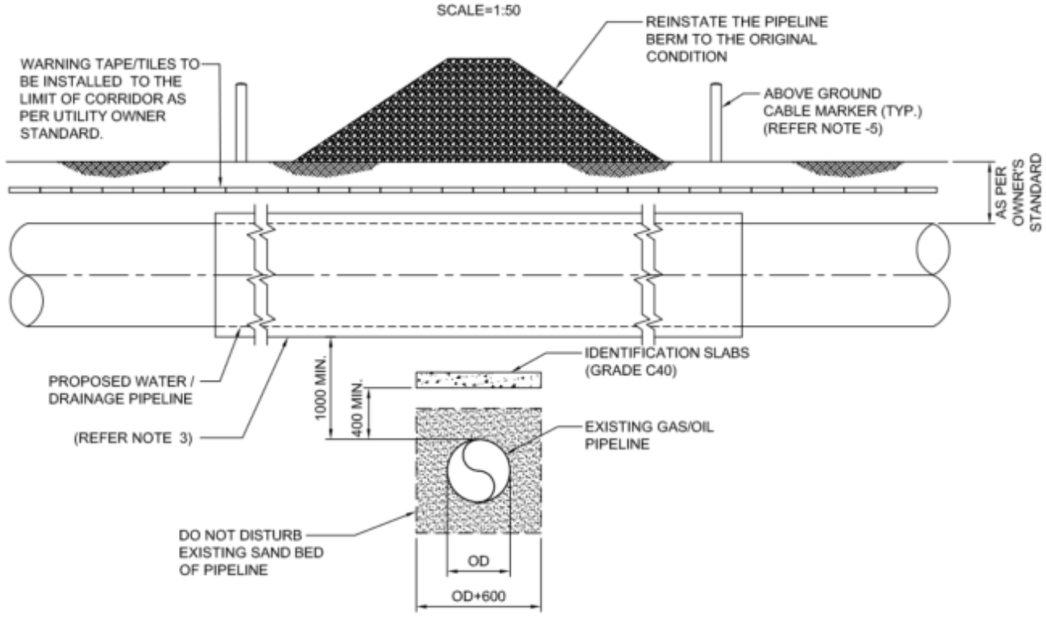
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
2. UTILITY CROSSING ABOVE EXISTING GAS/OIL PIPELINE IS PERMITTED ONLY FOR UTILITY LAYING WITHIN ROAD RIGHT OF WAY (ROW).
3. PROPOSED WATER/DRAINAGE MAIN LINE CROSSING OF DUSUP CORRIDOR/PIPELINE MUST BE ADEQUATELY DESIGNED AND PROTECTED IN ORDER TO ENSURE THAT, NO ADDITIONAL PERMANENT PROTECTION TO WATER/DRAINAGE LINE WILL BE REQUIRED DURING THE OPERATION AND MAINTENANCE OF EXISTING GAS/FUEL PIPELINES AND CONSTRUCTION OF FUTURE GAS/FUEL PIPELINE. THE FUTURE GAS/FUEL PIPELINE MAY BE CONSTRUCTED AT THE SAME LEVEL OF LOWEST PIPELINE IN THE CORRIDOR OR MINIMUM 3.0M BELOW EXISTING GRADE, WHICHEVER IS LOWER AND MINIMUM 1.0M UNRESTRICTED MAINTENANCE SPACE IS REQUIRED 360° OF EXISTING GAS/FUEL PIPELINE. WATER / DRAINAGE PROTECTION SLEEVE SHALL EXTEND 6M EITHER SIDE OF THE PIPELINE OR FULL LENGTH OF CORRIDOR, WHICH IS GREATER. SLEEVE JOINT SHALL NOT BE DIRECTLY ABOVE THE DUSUP PIPELINE CROSSING.
4. MANHOLE DEEPER THAN 1.5M, BENDS AND TRUST BLOCKS SHALL NOT BE LOCATED WITHIN THE DUSUP CORRIDOR/ROW INTERFACE AREA.
5. NEW UNDERGROUND CROSSING UTILITY MARKER SIGNS MUST BE INSTALLED EITHER SIDE OF THE PIPELINE CROSSING AND AT CORRIDOR LIMITS TO ASSIST FUTURE IDENTIFICATION OF THE CROSSING.
6. 150MM THICK PRE-CAST CONCRETE SLAB REINFORCED WITH A393 WELDED MESH AND COATED WITH MINIMUM TWO COATS OF APPROVED BITUMINOUS COATING, OR FIBER REINFORCED CONCRETE SLABS IN SMALLER SECTIONS (I.E. 500MM X 500MM X 50M THICK) TO BE PROVIDED. THE 50 MM THICK FIBER REINFORCED CONCRETE SLABS SHALL BE LAYERED SUCH THAT 150MM OVERALL THICKNESS IS ACHIEVED. 50MM THICK SLABS SHALL BE STAGGERED TO AVOID ALIGNING OF JOINTS. SLAB SHALL HAVE "HIGH PRESSURE GAS/FUEL PIPELINE" INSCRIPTION ON TOP.
7. THE CONTRACTOR SHALL PREPARE SEPARATE JOB SPECIFIC SHOP DRAWING USING THIS STANDARD DETAILS FOR DUSUP APPROVAL.
8. FOR CARBON STEEL PIPELINE CROSSING, SUITABLE CATHODIC PROTECTION BONDING AND TEST POST SHALL BE PROVIDED BETWEEN CROSSING PIPELINES. IN SOME CASES, THE NEW PIPELINE MAY REQUIRE ELECTRICAL SECTIONALIZATION. CATHODIC PROTECTION DETAILS ARE COVERED SEPARATELY.
9. 8MM DIA. GI LIFTING HOOK SHALL BE WRAPPED WITH DENSO TAPE AND COVERED WITH CEMENT MORTAR.



PLAN

SCALE=1:50



SECTION A-A

SCALE=1:50

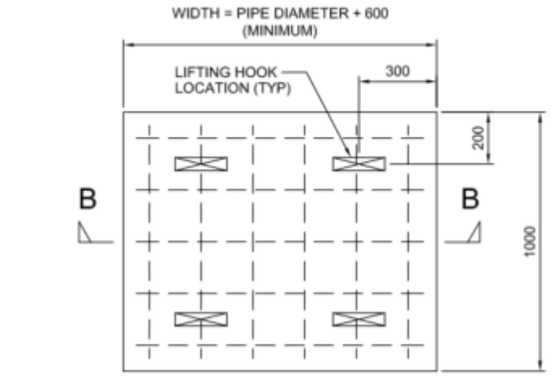
Rev.	Date	Revision Description	Drawn	Checked	Approved
1	03.02.2025	GENERAL REVISION	BV	SK	RRN
0	25.01.2022	First Issue	BV	RSK	RRN

Dubai Supply Authority

STANDARD DRAWING
WATER/DRAINAGE PIPELINE CROSSING
ABOVE EXISTING PIPELINE (OPEN CUT)

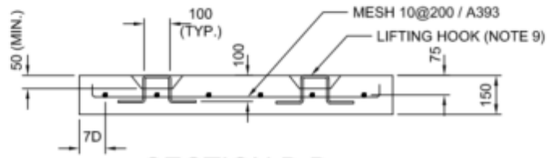
CAD File Name	Size	Scale	Area Code	Doc Code	Serial No.	Sheet of	Sheets	Rev. No.
900-08-060-001-R1 WATER CROSSING ABOVE PL.DWG	A3	AS SHOWN	900	08	0600	001	001	1

ATTACHMENT 4 - WATER/DRAINAGE LINE CROSSING BELOW



DETAIL 1 : IDENTIFICATION SLAB PLAN

SCALE=1:20

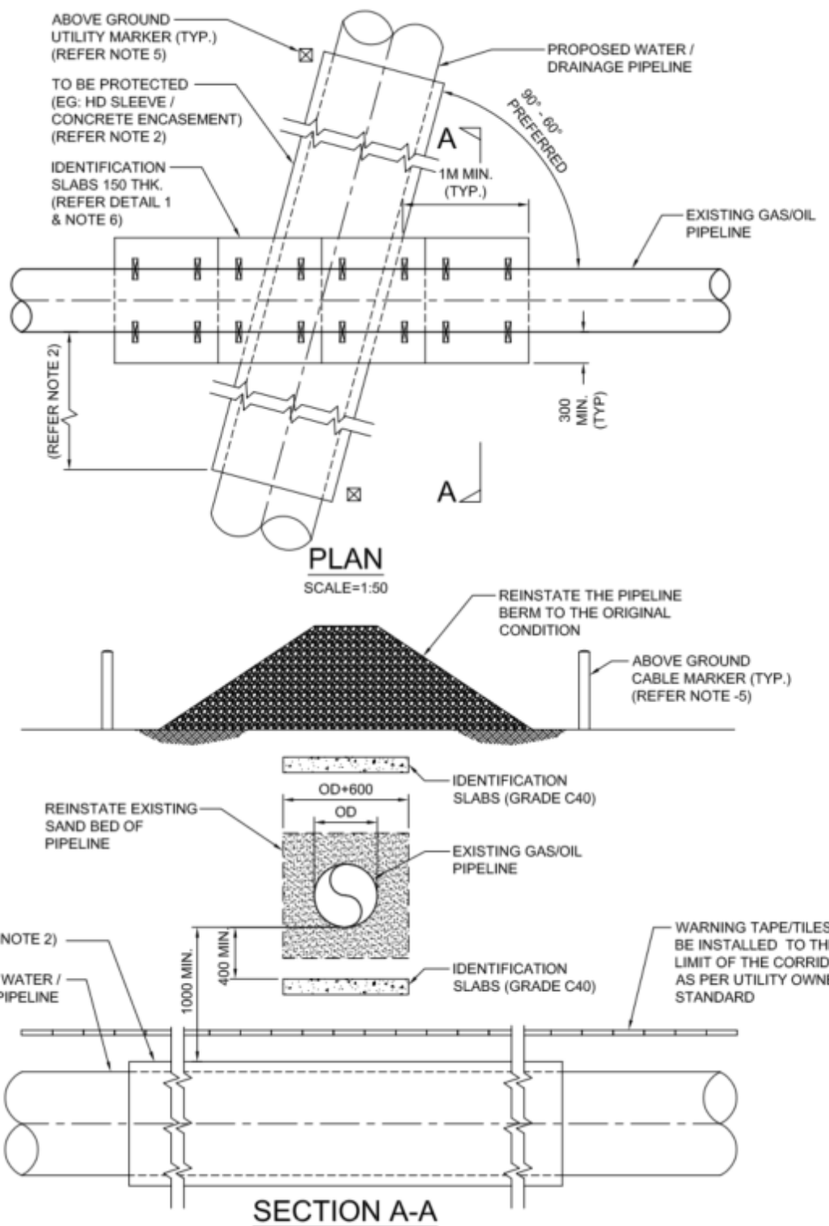


SECTION B-B

SCALE=1:20

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
2. PROPOSED WATER/DRAINAGE MAIN LINE CROSSING OF DUSUP CORRIDOR/PIPELINE MUST BE ADEQUATELY DESIGNED AND PROTECTED IN ORDER TO ENSURE THAT, NO ADDITIONAL PERMANENT PROTECTION TO WATER/DRAINAGE LINE WILL BE REQUIRED DURING THE OPERATION AND MAINTENANCE OF EXISTING GAS/FUEL PIPELINES AND CONSTRUCTION OF FUTURE GAS/FUEL PIPELINE. THE FUTURE GAS/FUEL PIPELINE MAY BE CONSTRUCTED AT THE SAME LEVEL OF LOWEST PIPELINE IN THE CORRIDOR OR MINIMUM 3.0M BELOW EXISTING GRADE, WHICHEVER IS LOWER AND MINIMUM 1.0M UNRESTRICTED MAINTENANCE SPACE IS REQUIRED 360° OF EXISTING GAS/FUEL PIPELINE. WATER / DRAINAGE PROTECTION SLEEVE SHALL EXTEND 6M EITHER SIDE OF THE PIPELINE OR FULL LENGTH OF CORRIDOR, WHICH IS GREATER. SLEEVE JOINT SHALL NOT BE DIRECTLY ABOVE THE DUSUP PIPELINE CROSSING.
3. MANHOLE DEEPER THAN 1.5M, BENDS AND TRUST BLOCKS SHALL NOT BE LOCATED WITHIN THE DUSUP CORRIDOR/ROW INTERFACE AREA.
4. MAXIMUM SUPPORT SPAN FOR EXPOSED PIPELINE IS 10M.
5. NEW UNDERGROUND CROSSING UTILITY MARKER SIGNS MUST BE INSTALLED EITHER SIDE OF THE PIPELINE CROSSING AND AT CORRIDOR LIMITS TO ASSIST FUTURE IDENTIFICATION OF THE CROSSING.
6. 150MM THICK PRE-CAST CONCRETE SLAB REINFORCED WITH A393 WELDED MESH AND COATED WITH MINIMUM TWO COATS OF APPROVED BITUMINOUS COATING, OR FIBER REINFORCED CONCRETE SLABS IN SMALLER SECTIONS (I.E. 500MM X 500MM X 50M THICK) TO BE PROVIDED. THE 50 MM THICK FIBER REINFORCED CONCRETE SLABS SHALL BE LAYERED SUCH THAT 150MM OVERALL THICKNESS IS ACHIEVED. 50MM THICK SLABS SHALL BE STAGGERED TO AVOID ALIGNING OF JOINTS. SLAB SHALL HAVE "HIGH PRESSURE GAS/FUEL PIPELINE" INSCRIPTION ON TOP.
7. THE CONTRACTOR SHALL PREPARE SEPARATE JOB SPECIFIC SHOP DRAWING USING THIS STANDARD DETAILS FOR DUSUP APPROVAL.
8. FOR CARBON STEEL PIPELINE CROSSING, SUITABLE CATHODIC PROTECTION BONDING AND TEST POST SHALL BE PROVIDED BETWEEN CROSSING PIPELINES. IN SOME CASES, THE NEW PIPELINE MAY REQUIRE ELECTRICAL SECTIONALIZATION. CATHODIC PROTECTION DETAILS ARE COVERED SEPARATELY.
9. 8MM DIA. GI LIFTING HOOK SHALL BE WRAPPED WITH DENSO TAPE AND COVERED WITH CEMENT MORTAR.



PLAN

SCALE=1:50

SECTION A-A

SCALE=1:50

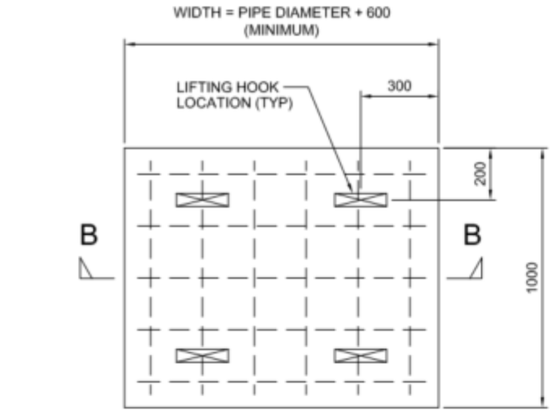
Rev.	Date	Revision Description	Drawn	Checked	Approved
1	03.02.2025	GENERAL REVISION	BV	SK	RRN
0	25.01.2022	First Issue	BV	RSK	RRN

Dubai Supply Authority

STANDARD DRAWING
WATER/DRAINAGE PIPELINE CROSSING
BELOW EXISTING PIPELINE (OPEN CUT)

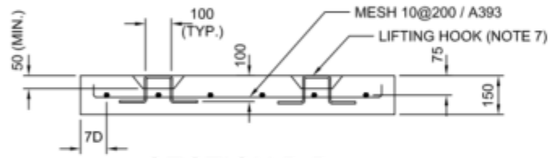
CAD File Name	Size	Scale	Area Code	Doc Code	Serial No.	Sheet of	Sheets	Rev. No.
900-08-061-001-R1 WATER CROSSING BELOW PL.DWG	A3	AS SHOWN	900	08	061	001	001	1

ATTACHMENT 5 - HYDROCARBON PIPELINE CROSSING BELOW



DETAIL 1 : IDENTIFICATION SLAB PLAN

SCALE=1:20

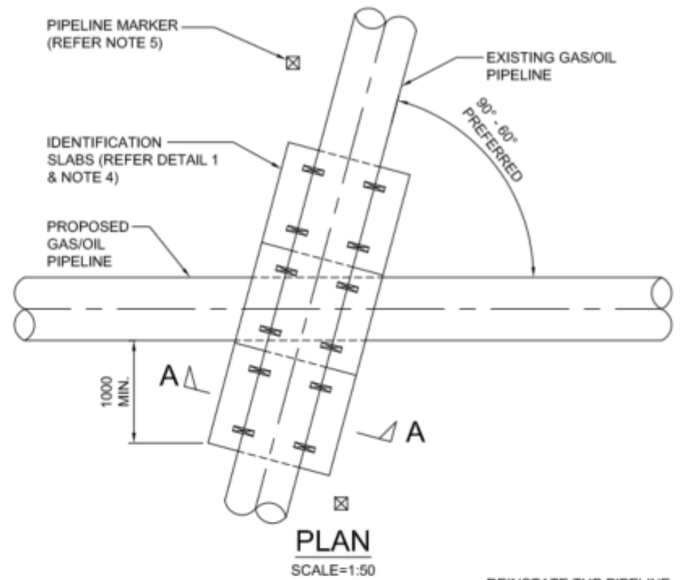


SECTION B-B

SCALE=1:20

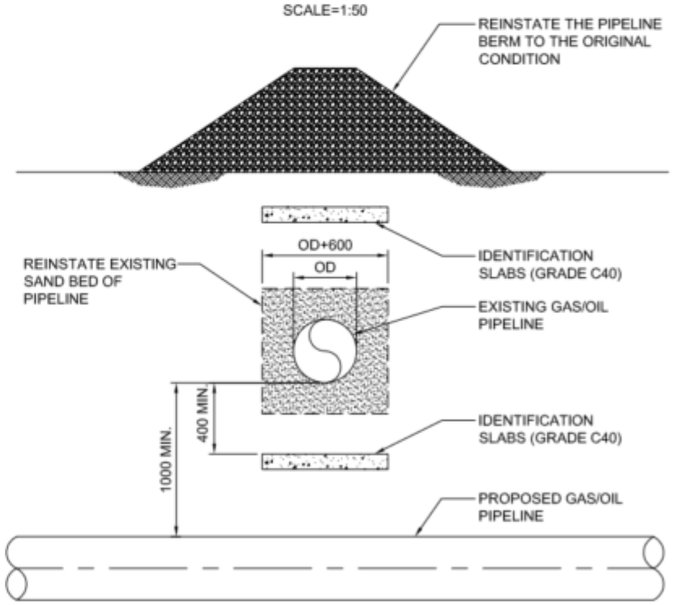
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
2. SUITABLE CATHODIC PROTECTION BONDING AND TEST POINT SHALL BE PROVIDED BETWEEN CROSSING PIPELINES. IN SOME CASES, THE NEW PIPELINE MAY REQUIRE ELECTRICAL SECTIONALIZATION. CATHODIC PROTECTION DETAILS ARE COVERED SEPARATELY.
3. MAXIMUM SUPPORT SPAN FOR EXPOSED PIPELINE IS 10M.
4. 150MM THICK PRE-CAST CONCRETE SLAB REINFORCED WITH A393 WELDED MESH AND COATED WITH MINIMUM TWO COATS OF APPROVED BITUMINOUS COATING, OR FIBER REINFORCED CONCRETE SLABS IN SMALLER SECTIONS (I.E. 500MM X 500MM X 50M THICK) TO BE PROVIDED. THE 50 MM THICK FIBER REINFORCED CONCRETE SLABS SHALL BE LAYERED SUCH THAT 150MM OVERALL THICKNESS IS ACHIEVED. 50MM THICK SLABS SHALL BE STAGGERED TO AVOID ALIGNING OF JOINTS. SLAB SHALL HAVE "HIGH PRESSURE GAS/FUEL PIPELINE" INSCRIPTION ON TOP.
5. PIPELINE OWNERS STANDARD PIPELINE MARKER SIGNS MINIMUM AT THE BENDS WITHIN THE CORRIDOR.
6. THE CONTRACTOR SHALL PREPARE SEPARATE JOB SPECIFIC SHOP DRAWING USING THIS STANDARD DETAILS FOR DUSUP APPROVAL.
7. 8MM DIA. GI LIFTING HOOK SHALL BE WRAPPED WITH DENSO TAPE AND COVERED WITH CEMENT MORTAR.



PLAN

SCALE=1:50



SECTION A-A

SCALE=1:50

Rev.	Date	Revision Description	Drawn	Checked	Approved
1	03.02.2025	GENERAL REVISION	BV	SK	RRN
0	26.01.2022	First Issue	BV	RSK	RRN

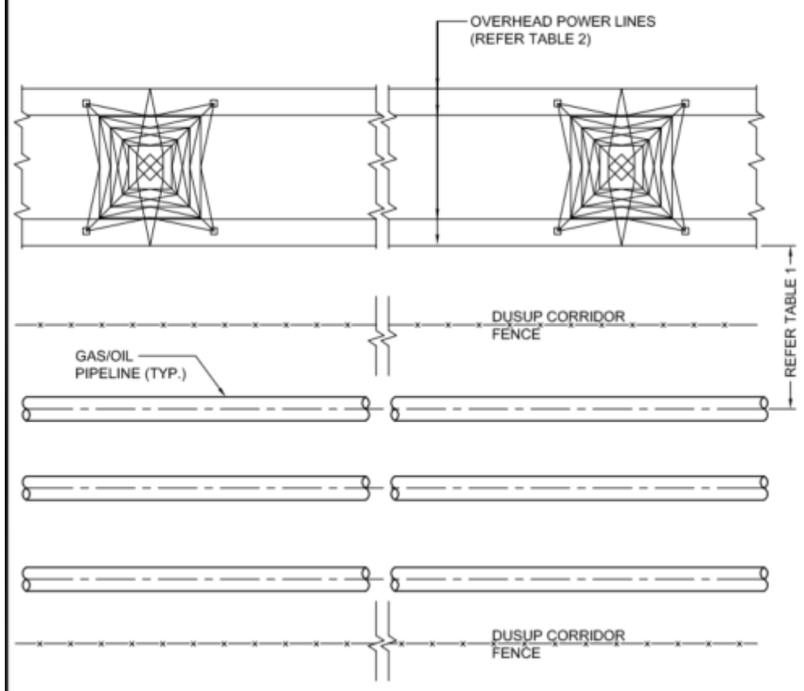
Dubai Supply Authority

STANDARD DRAWING
HYDROCARBON PIPELINE CROSSING
BELOW EXISTING PIPELINE (OPEN CUT)

CAD File Name	Size	Scale	Area Code	Doc Code	Serial No.	Sheet of	Sheets	Rev. No.
900-08-062-001-R1 HC PL CROSSING BELOW PL.DWG	A3	AS SHOWN	900	08	062	001	001	1

ATTACHMENT 6- MINIMUM SEPARATION FOR OHL

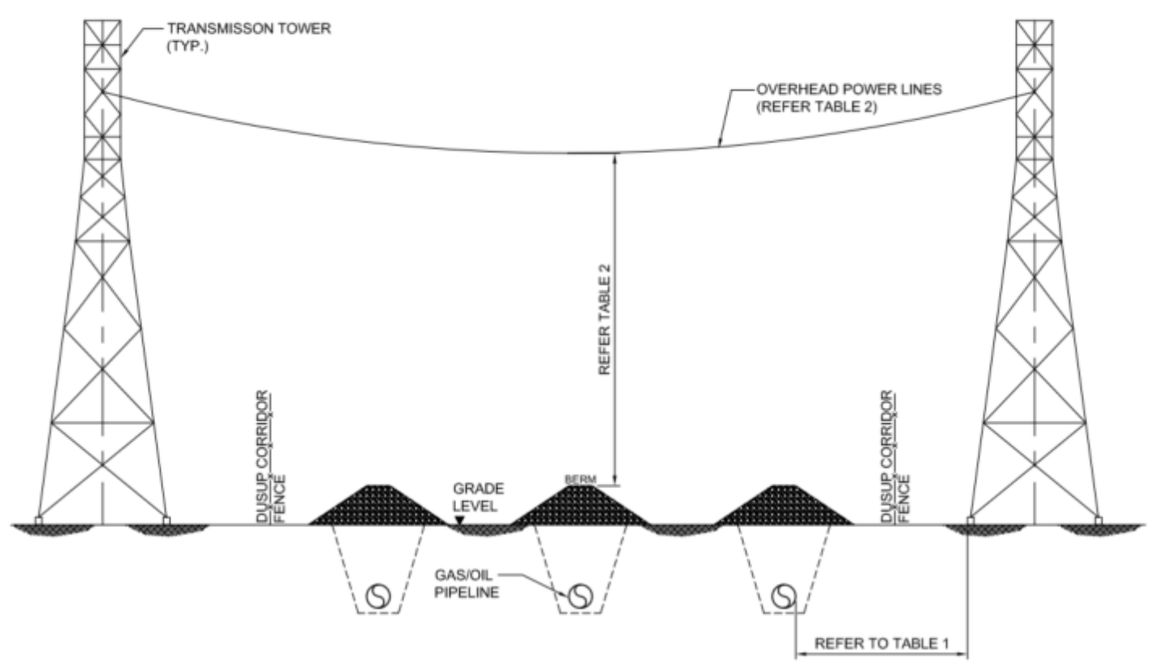
PIPELINE PARALLEL TO HV O/H POWER TRANSMISSION LINE



PLAN VIEW

TABLE 1 (NOTE 2)	
SYSTEM VOLTAGE (KV)	MIN. DISTANCE (M)
6.6/11/33	10.00
132/400	25M FOR 150MM DIA 50M FOR 180 - 450 MM DIA 100M FOR >450 MM DIA

PIPELINE CROSSING TO HV O/H POWER TRANSMISSION LINE



SECTIONAL VIEW

TABLE 2: DEWA RECOMMENDATIONS (NOTE 2, 3 & 4)	
SYSTEM VOLTAGE (KV)	MIN. HEIGHT (M)
6.6/11	8.50
33	9.00
132	9.75
400	13.50

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.
2. THE MINIMUM CLEARANCES PROVIDED IN THE DRAWINGS ARE AS PER DEWA REQUIREMENTS. HOWEVER, APPROVED DISTANCES SHALL BE CONFIRMED AFTER INTERFERENCE STUDY ONLY, AS PER NOTE 7.
3. WHERE THE PIPELINE IS ABOVE GRADE, THE MINIMUM HEIGHT REQUIREMENTS SHALL BE MEASURED FROM THE TOP OF BERM.
4. GROUND CLEARANCE SHALL BE CHECKED DURING MAXIMUM TEMPERATURE IN STILL AIR.
5. DETAILED CP CALCULATIONS SHALL BE CARRIED FOR EACH CROSSING FOR ADOPTING MITIGATION MEASURES REQUIRED FOR PROTECTING THE PIPELINE AND TO PREVENT INTERFERENCE WITH PIPELINE CP SYSTEM. CALCULATIONS AND PROPOSED MITIGATIONS SHALL BE APPROVED BY THE COMPANY.
6. HIGH VOLTAGE TERMINAL BOX (CP MONITORING TEST POST) SHALL BE PROVIDED AT EACH CROSSING.
7. AN INTERFERENCE STUDY OF THE OVERHEAD LINE CABLES ON EXISTING PIPELINE(S) MUST BE CONDUCTED BY THE INITIATING PARTY TO DETERMINE THE POSSIBLE IMPACT ON THE EXISTING HYDROCARBON PIPELINES. THE INTERFERENCE STUDY SHALL BE CARRIED OUT FOR BOTH PARALLEL AND CROSSING INSTALLATIONS USING A DUSUP APPROVED SPECIALIST CONTRACTOR. APPROVED MITIGATION MEASURE SHALL BE IMPLEMENTED BY INITIATING PARTY.
8. THE CONTRACTOR SHALL PREPARE SEPARATE JOB SPECIFIC SHOP DRAWING USING THIS STANDARD DETAILS FOR DUSUP APPROVAL.

Rev.	Date	Revision Description	Drawn	Checked	Approved
1	03.02.2025	GENERAL REVISION	BV	SK	RRN
0	21.01.2022	First Issue	BV	RSK	RRN

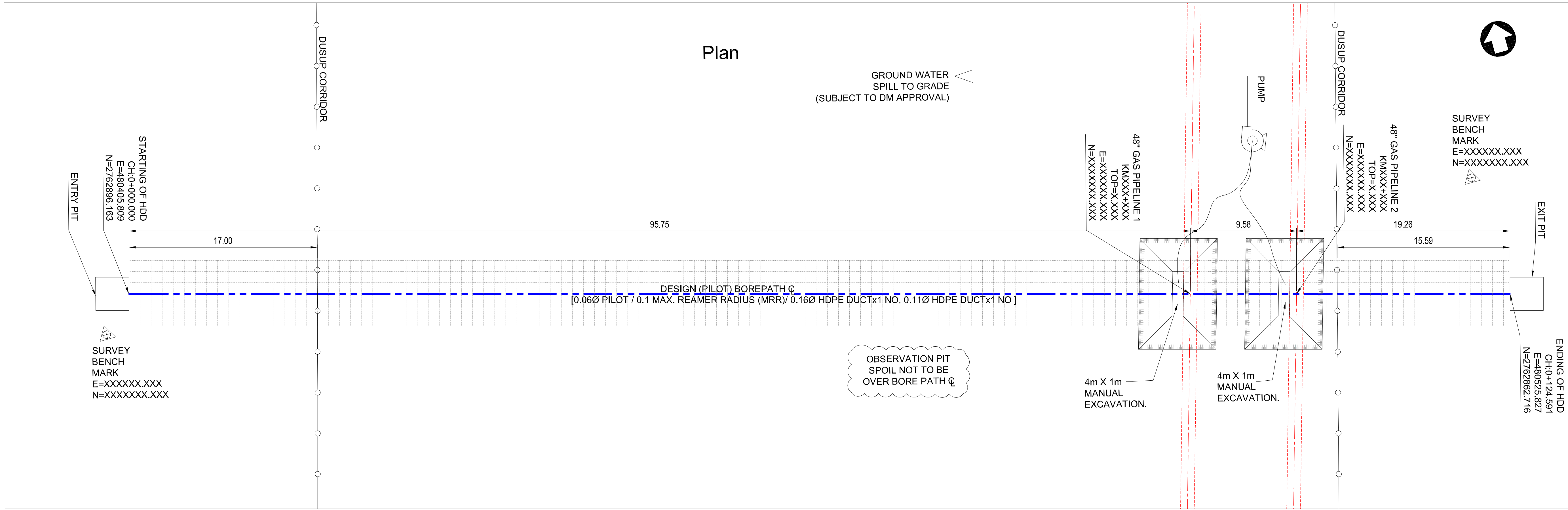
Dubai Supply Authority

STANDARD DRAWING
MINIMUM SEPARATION FOR OVERHEAD LINES
(PARALLEL AND CROSSING)

CAD File Name	Size	Scale	Area Code	Doc Code	Serial No.	Sheet of	Sheets	Rev. No.
900-08-059-001-R1 MINIMUM SEPARATION OHL.DWG	A3	NTS	900	08	059	001	001	1

ATTACHMENT 7 – TRENCHLESS HDD PROFILE DRAWING TEMPLATE

Plan



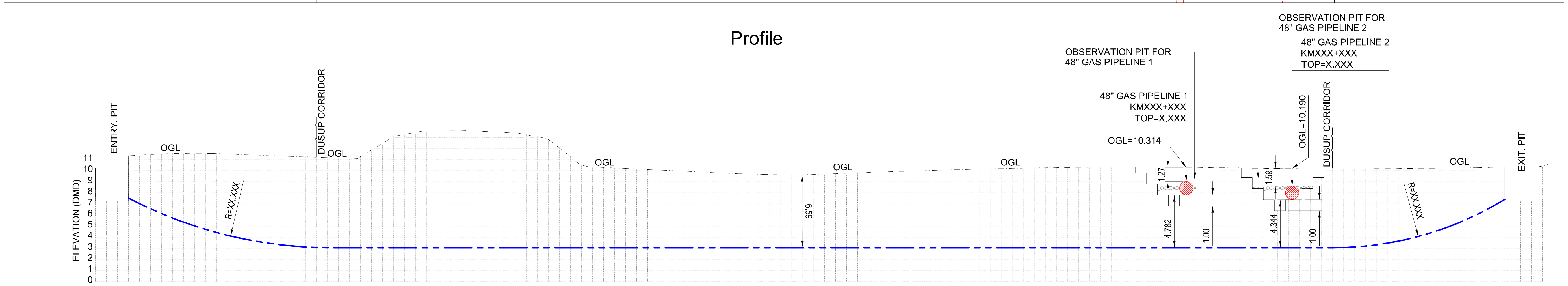
NOTES:

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE STATED.
2. ALL CO-ORDINATES ARE REFERRED TO DLTM (DUBAI LOCAL TRANSVERSE MERCATOR).
3. ELEVATIONS ARE REFERRED TO DUBAI MUNICIPALITY DATUM (DMD)
4. ORIGINAL GROUND LEVEL (OGL) TO BE CONFIRMED AS PER APPROVED BORE PATH DRAWING PRIOR TO DRILLING COMMENCING
5. SUBMERSIBLE (MUD PUMP) TO BE PROVIDED AS CONTINGENCY IN OBSERVATION PIT/S IN THE EVENT OF A 'FRAC-OUT'
6. ROW **P, Q & R** ARE TO BE FILLED FOR NON-WALKOVER LOCATING SYSTEM.

ABBREVIATIONS:

BOP	BOTTOM OF PIPE
CH	CHAINAGE
℄	CENTERLINE
DMD	DM DATUM
EL	ELEVATION
GL	GROUND LEVEL
HC	HYDROCARBON
KM	KILOMETER
MRR	MAX. REAMER RADIUS
OGL	ORIGINAL GL
P/L	PIPELINE
TL	TOP LEVEL
TOP	TOP OF PIPE

Profile



BLACK: DESIGN DATA / CALC.

GREEN: LOCATING SYSTEM

BLUE: DESIGN BORE PATH ℄

A	DRILL ROD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	
B	ROD LENGTH	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	
C	HDD CHAINAGE	3.00	6.00	9.00	12.00	15.00	18.00	21.00	24.00	27.00	30.00	33.00	36.00	39.00	42.00	45.00	48.00	51.00	54.00	57.00	60.00	63.00	66.00	69.00	72.00	75.00	78.00	81.00	84.00	87.00	90.00	93.00	96.00	99.00	102.00	105.00	108.00	111.00	114.00	117.00	120.00	123.00	124.591	
D	ROUTE CHAINAGE																																											
E	GRADE EL	11.347	11.524	11.584	11.513	11.393	11.288	11.194	11.279	13.101	13.592	13.619	13.517	13.262	12.072	10.339	10.205	10.068	9.928	9.793	9.686	9.634	9.71	9.819	9.921	10.016	10.1	10.174	10.236	10.284	10.317	10.333	10.332	10.312	10.274	10.23	10.193	10.175	10.176	10.191	10.217	10.250	10.250	10.346
F	DESIGN BORE PATH ℄EL	7.529	6.128	5.015	6.164	3.559	3.188	3.045	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.111	3.465	4.133	5.138	6.518	7.412
G (E-F)	DESIGN BORE DEPTH REL.GL	3.818	5.396	6.569	7.348	7.834	8.100	8.149	8.236	10.058	10.549	10.576	10.474	10.219	9.029	7.296	7.162	7.025	6.885	6.750	6.643	6.591	6.667	6.776	6.879	6.973	7.058	7.131	7.193	7.241	7.274	7.291	7.289	7.269	7.231	7.187	7.150	7.132	7.065	6.726	6.084	5.122	3.775	2.934
H	HC PIPE BOP EL																										HC PIPE BOP EL (CALCULATED FROM TRIAL PIT DATA)							7.825			7.387							
I (H-F-MRR)	DESIGN SEPARATION BOP TO TOP OF REAMER																																	4.632			4.194							
J	RECEIVER BORE DEPTH REL.GL							4.035			7.293			7.6			5.1			4.9			4.9		5.1		5.2		5.1	5.0	4.9	4.7	4.6	4.3	4.1	3.8	3.5	3.1						
K (E-J)	LOCATOR BORE PATH ℄EL							7.158			6.299			5.6			5.1			4.9			4.8		4.8		4..9		5.1	5.2	5.3	5.5	5.5	5.9	6.2	6.5	6.7	7.1						
L (H-K-MRR)	CLEARANCE (LOCATOR) BOP TO TOP OF REAMER																																	2.0			0.6							
M	PITCH / INCLINATION (% / DEGREES)																																											
N	ROLL (24 Hrs Clock)																																											
O	RIGHT (+) / LEFT (-)							-1.1			-1.4			-1.7									-1.1				-0.9		-0.7	-0.6	-0.6													
P (NOTE 6)	DEPTH CORRECTION																																											
Q (NOTE 6)	ELEVATION (DMD)																																											
R (NOTE 6)	DIRECTION																																											
S	OTHER																																											

COLUMN LINES TO REFLECT EXPECTED SURVEY/ RECEIVER DATA COLLECTION POINTS (COURSE LENGTH POINTS)

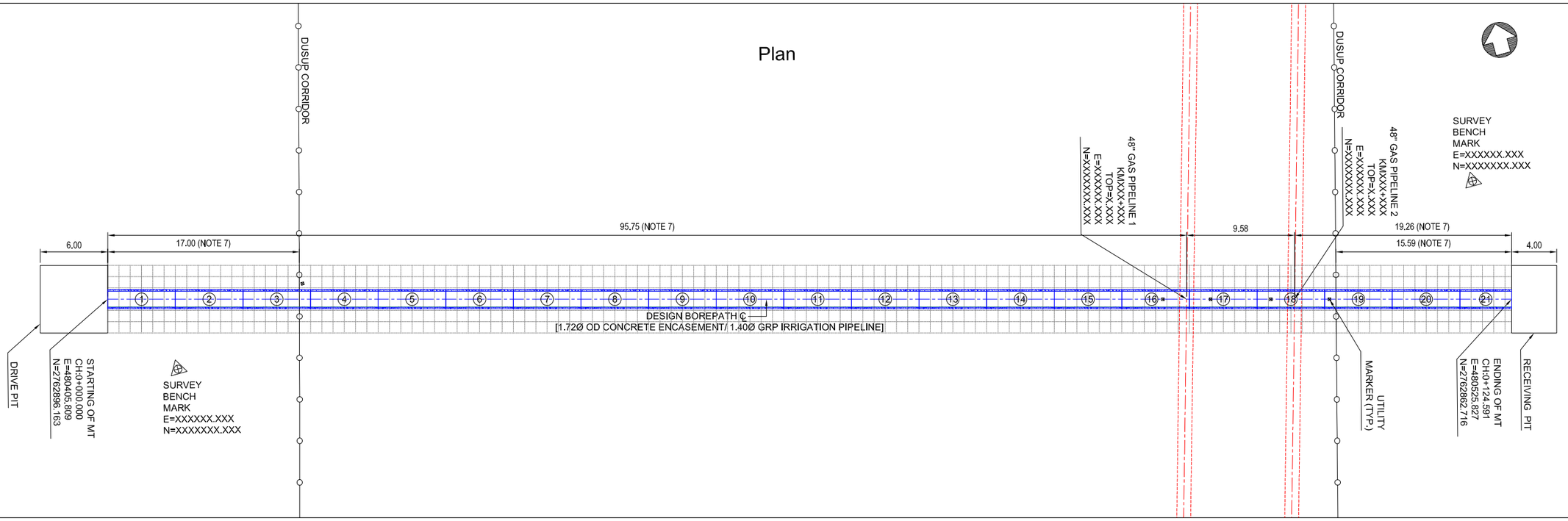
PILOT NOT SIGHTED
OK TO PROCEED
WITH REAMING

PILOT SIGHTED
-ALL STOP
-TO PROCEED SUBJECT TO PIPELINE OWNER REVIEW

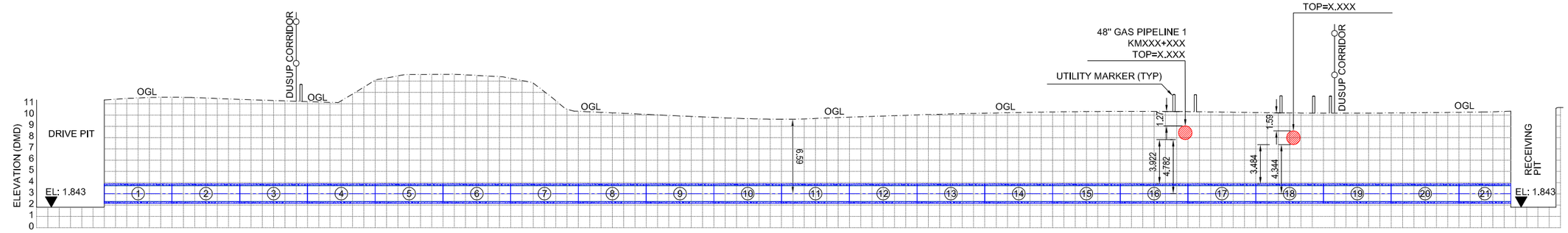
SCALE = 1:400 ON A3 SIZE

ATTACHMENT 8 – TRENCHLESS (NON-HDD) PROFILE DRAWING TEMPLATE

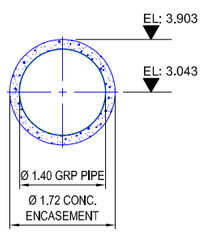
Plan



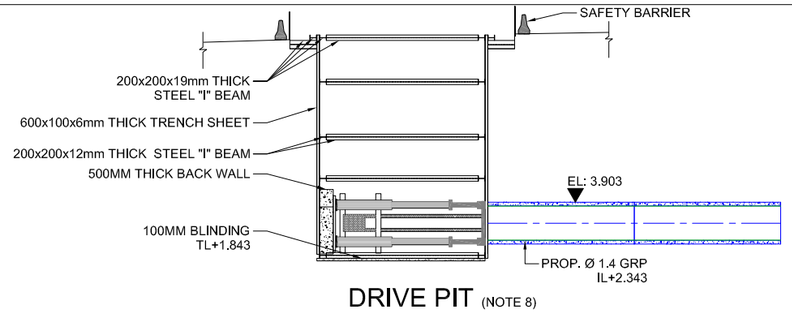
Profile



A	ENCASE PIPE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
B	PIPE LENGTH	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	4.59
C	MT CHAINAGE	6.00	12.00	18.00	24.00	30.00	36.00	42.00	48.00	54.00	60.00	66.00	72.00	78.00	84.00	90.00	96.00	102.00	108.00	114.00	120.00	124.59
D	DIST TO HC PL																95.75		105.332			
E	GRADE EL	11.581	11.393	11.194	13.101	13.619	13.262	10.339	10.068	9.793	9.634	9.819	10.016	10.174	10.284	10.333	10.312	10.230	10.175	10.191	10.250	10.346
F	DESIGN BORE PATH ℄ EL (DMD)	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043	3.043
G (E-F)	DESIGN BORE DEPTH REL GL	8.541	8.35	8.151	10.058	10.576	10.219	7.296	7.025	6.75	6.591	6.776	6.973	7.131	7.241	7.291	7.269	7.187	7.132	7.148	7.207	7.303
H	HC PIPE BOP EL													HC PIPE BOP EL (CALCULATED FROM TRIAL PIT DATA)			7.825		7.387			
I	CASING PIPE TOP EL	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903	3.903



CONC. ENCASED PIPE



DRIVE PIT (NOTE 8)

NOTES:

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE STATED.
2. ALL CO-ORDINATES ARE REFERRED TO DLTM (DUBAI LOCAL TRANSVERSE MERCATOR).
3. ELEVATIONS ARE REFERRED TO DUBAI MUNICIPALITY DATUM (DMD)
4. ORIGINAL GROUND LEVEL (OGL) TO BE CONFIRMED AS PER APPROVED BORE PATH DRAWING PRIOR TO DRILLING COMMENCING
5. FOR LONG MICRO TUNNELLING ROUTES (I.E. > 200 M), INTERMEDIATE JACKING STATIONS (IJS) MAY REQUIRE TO BE UTILISED. IJS SHALL BE LOCATED 10M, HORIZONTALLY, FROM THE PIPELINE LOCATION. DUSUP MAY ALLOW IJS TO BE LOCATED WITHIN 10M OF A PIPELINE (BUT NOT WITHIN 5 M)
6. THE MINIMUM HORIZONTAL SEPARATION DISTANCES BETWEEN THE NEAREST EDGES OF THE LAUNCH AND RECEIVE PIT TO THE EDGE OF THE HYDROCARBON PIPELINE(S) IS 15 METERS WITH A PREFERRED SEPARATION OF 20 METERS. FURTHER, ENTRY AND EXIT PITS MUST BE MINIMUM 5 M AWAY FROM DUSUP FENCE
7. THE MINIMUM VERTICAL SEPARATION BETWEEN THE BOTTOM OF LOWEST HYDROCARBON PIPELINE IN THE CORRIDOR AND THE TOP OF CROSSING SLEEVE/UTILITY MUST BE 2.0 METERS FOR CROSSING SLEEVES UP TO AND INCLUDING ONE (1.0) METER DIAMETER AND MINIMUM OF 2.0 TIMES THE SLEEVE DIAMETER FOR TRENCHLESS CROSSING SLEEVE GREATER THAN ONE (1.0) METER DIAMETER
8. DRIVE PIT DETAILS INCLUDING SHORING, BACK WALL AND BLINDING ARE PROVIDE IN THIS SHEET FOR REFERENCE PURPOSES ONLY. MICRO TUNNELING CONTRACTOR SHALL PROVIDE THE DESIGN OF DRIVE AND RECEIVING PITS.

ABBREVIATIONS:

BOP	BOTTOM OF PIPE
CH	CHAINAGE
℄	CENTERLINE
DMD	DM DATUM
EL	ELEVATION
GL	GROUND LEVEL
HC	HYDROCARBON
IL	INVERT LEVEL
KM	KILOMETER
MT	MICRO TUNNELING
OD	OUTER DIAMETER
OGL	ORIGINAL GL
P/L	PIPELINE
TL	TOP LEVEL
TOP	TOP OF PIPE

SCALE = 1:400 ON A3 SIZE

ATTACHMENT 9A - NOC CHECK LIST FOR NON-HDD TRENCHLESS CROSSING

NOC NUMBER		LOCATION	
NO.	**DESCRIPTIONS**	**Y/N**	**COMMENT**
1	NDRC contractor is approved by RTA? Contractor to upload RTA NDM Qualification Letter.		
2	Machine Operators qualification has been verified by the Consultant and included in submission?		
3	Verified copy of trial pit record available and matching with submitted drawing?		
4	Site set-up layout and location are reviewed considering the safety of DUSUP assets and operations?		
5	Elevation and coordinates in drawing are as per DM datum?		
6	Geotechnical / soil investigation was carried out and results were considered in design of crossing?		
7	Drawing / details of Thrust wall, Entry & Exit Pits are reviewed against design document and method statement?		
8	DUSUP corridor limits are shown on Plan & Profile drawing?		
9	Entry pit floor / blinding top elevations, railing top elevations are verified to ensure minimum vertical separation from the bottom of pipeline to the top of crossing sleeve is available as per DUSUP guideline #158.		
10	Crossing depth (to the top of crossing) within the corridor shall not be shallower than 4.5m from the lowest ground along the crossing route, or the lowest pipeline including the required separation distance, whichever is lower.		

NOC NUMBER		LOCATION	
NO.	**DESCRIPTIONS**	**Y/N**	**COMMENT**
11	Minimum horizontal separations to the pipelines are maintained as mentioned in DUSUP Guidelines #158?		
12	Interjacking station (IJS) is located minimum 10m distance from the existing pipeline?		
13	Dewatering submission, if applicable is satisfactory?		
14	All existing utilities verified at crossing route are shown on the drawing?		
15	Contingency plan is available in case of equipment failure?		
16	Proposed crossing is adequately designed, considering no additional protection is needed during the construction of future DUSUP pipeline and confirmation is included in the submission.		
17	Presence of existing utility parallel to proposed crossing and its impact on future DUSUP pipeline construction is reviewed and found satisfactory?		
19	Utilities markers provided at edge of corridor and at crossing locations?		
20	All latest updated drawings/documents are uploaded in e-NOC internal folder?		
21	Other Pipeline Owners approval (if applicable) is available?		

ATTACHMENT 9B - NOC CHECK LIST FOR HDD CROSSING

NOC NUMBER		LOCATION	
NO.	**DESCRIPTIONS**	**Y/N**	**COMMENT**
1	NDRC contractor is approved by RTA? Contractor to upload RTA HDD Qualification Letter.		
2	Drilling & Tracking Operators qualification / certificate has been verified by the Consultant (via letter or equivalent) and included in submission?		
3	The elevations and coordinates in submitted drawing are as per DM datum and matching with Trial Pit record?		
4	Geotechnical / soil investigation was carried out for the design of crossing?		
5	Profile drawing is prepared as per DUSUP standard template? Contractors shall fill in the HDD profile table detailing lengths, depths, distances from pipeline every 5 m etc.		
6	DUSUP corridor limits are shown on Plan & Profile drawing?		
7	Minimum horizontal & vertical separations to the pipelines are maintained as mentioned in DUSUP Guidelines #158?		
8	Crossing depth (to the top of crossing) within the corridor shall not be shallower than 4.5m from the lowest ground along the crossing route, or the lowest pipeline including the required separation distance, whichever is lower.		
9	Drill rod entry and exit point elevation & coordinates are included in drawing?		
10	Distance of drill rod end to sensor / probe detailed in method statement and length taken into account in rod profile?		

NOC NUMBER		LOCATION	
NO.	**DESCRIPTIONS**	**Y/N**	**COMMENT**
11	Chainage, elevation, and depth are shown at each drill rod ends, crossing locations, corridor edge and 5m either side of crossing? Refer to No 6 for profile drawing.		
12	Dewatering submission, if applicable is satisfactory?		
13	Observation pit is provided as stated in guideline #158? Otherwise 5m separation distance (min) required		
14	Entry and exit pit minimum 15 m away from pipeline (preferably 20 m) and out with DUSUP corridor limit.		
15	Tracking and recording, or Realtime witnessing of drilling profile are described in detail in method statement?		
16	Site calibration of tracking device with pipeline representative present, is described in method statement?		
17	For Wireline tracking, surface coil installation across route and location coordinates are shown on the drawing, and installation is covered in method statement?		
18	Presence of existing utility parallel to proposed crossing and its impact on future DUSUP pipeline construction is reviewed and found satisfactory?		
19	Utilities markers provided at edge of corridor and at crossing locations?		
20	All existing utilities verified at crossing route are shown on the drawing?		
21	Equipment maintenance history provided for the last 6 months.		
22	Contingency plan in case of equipment failure is included in submission?		

NOC NUMBER		LOCATION	
NO.	**DESCRIPTIONS**	**Y/N**	**COMMENT**
23	MSRA is job specific and location specific and approved by NDRC consultant?		
24	All resubmitted drawing /document are numbered with new revision numbers?		
25	All latest updated drawings/documents are uploaded in e-NOC internal folder?		
26	Other Pipeline Owners approval (if applicable) is available?		

ATTACHMENT 10A - PIPELINE REPRESENTATIVE CHECK LIST FOR NON-HDD TRENCHLESS CROSSING

NOC NUMBER		LOCATION	
NO.	**DESCRIPTIONS**	**Y/N**	**COMMENT**
1	NOC Engineer Checklist verified at site.		
2	Site set-up is done as per approved NOC?		
3	Copy of specialist NDRC (Non-HDD) contractor and NDRC consultants signed inspection document for “OK to proceed” is available at site?		
4	MSRA has cross checked and confirmed for completeness?		
5	Machine Operators valid Vocational Certificate with EID Identification is available at site?		
6	Machine Operators qualification has been verified by the Consultant?		
7	Machine’s fit to use inspection document and certificates, verified by the **consultant** or **approved third party certifying agency** are available at site?		
8	Utility Owners NOC (if applicable) is available at site?		
9	Approved drawings including crossing profile are available at site?		
10	A copy of DUSUP verified TP records available at site?		
11	DM Benchmark of Tunnel Boring Machine as per DM Benchmark and surveyor are available at site?		
12	Thrust wall, Entry & Exit pits are constructed as per the approved drawing?		
13	Horizontal distance between edge of entry/exit pit to edge of existing pipeline are as per approved drawing?		
14	Method of checking tunnelling alignment and maintaining separation distance from the pipeline are matching with approved NOC submission.		
15	Elevation of entry pit and drilling alignments are verified and recorded as per DM Benchmark?		
16	Existing ground elevation along the drilling route is recorded for settlement monitoring?		
17	Verified existing utility locations are marked at site?		

NOC NUMBER		LOCATION	
NO.	**DESCRIPTIONS**	**Y/N**	**COMMENT**
18	Drilling log is available at site for real-time inspection?		
19	If applicable, dewatering work is carried out as per the approved NOC?		
20	Condition of DUSUP corridor fence, if affected is recorded before and after work for reinstatement?		
21	Contingency plan is available in case of equipment failure?		
22	Restoration work at entry and exit pit (in close proximity of DUSUP corridor) is satisfactory?		
23	For steel sleeve crossing, has CP Posts been provided on the sleeve and cross bonded with the DUSUP Pipeline?		

ATTACHMENT 10B - PIPELINE REPRESENTATIVE CHECK LIST FOR HDD - WALKOVER TRACKING DEVICE

NOC NUMBER		LOCATION	
NO.	**DESCRIPTIONS**	**Y/N**	**COMMENT**
1	NOC Engineer Checklist verified at site.		
2	Copy of specialist HDD contractors and NDRC consultants signed inspection document for “OK to proceed” is available at site?		
3	Drilling machine and tracking device are matching with approved NOC submission.		
4	Drilling and Tracking Operators qualification has been verified by the NDRC Consultant		
5	A copy of DUSUP verified TP records available at site?		
6	Approved drawings including crossing profile are available at site?		
7	MSRA has cross checked and confirmed for completeness?		
8	Utility Owners NOC is available at site (if applicable)?		
9	Horizontal distance between edge of entry/exit pit to edge of existing pipeline is as per approved drawing?		
10	Observation pit is available and extended minimum 2.0m either side of centreline of bore and as per approved NOC drawing?		
11	Verified existing utility locations are marked at site?		
12	Bore centreline is marked at site?		
13	Elevation of existing ground/berm at crossing location against Trial pit record and 5m either side of crossing against approved NOC drawing is verified		
14	Elevation and coordinates at entry point (zero chainage) and exit point is recorded as per DM Benchmark?		
15	If the ground elevation is higher than recorded during Trial Pit, NOC engineer was consulted for reassessment and advise?		
16	If the existing berm is not recorded in Trial Pit record, NOC engineer was consulted for reassessment and advise?		
17	Is communication arrangement between the HDD Drilling Operator and Tracking Device Operator is available?		
18	Drilling log is available for recording?		
19	Tracking device is calibrated before commencement of drilling?		

NOC NUMBER		LOCATION	
NO.	**DESCRIPTIONS**	**Y/N**	**COMMENT**
20	Tracking of pilot is recorded at each drill rod ends, crossing locations and 5m either side of crossing?		
21	Availability of approved minimum vertical separation of pilot drill is verified and confirmed before reaming activities?		
22	If Frac-out / settlement issue is observed along the drilling route or within the observation pit, NDRC consultant assessment is carried out and action plan is agreed with NOC engineer.		
23	Observation pit is backfilled & compacted, and berm reinstated to the original condition?		
24	Brief HDD contractor on XYZ mapping preparation requirements?		
25	Contingency plan is available in case of equipment failure?		
26	Restoration work at entry and exit pit (in close proximity of DUSUP corridor) is satisfactory?		

ATTACHMENT 10C - PIPELINE REPRESENTATIVE CHECK LIST FOR HDD - WIRELINE TRACKING

NOC NUMBER		LOCATION	
NO.	**DESCRIPTIONS**	**Y/N**	**COMMENT**
1	NOC Engineer Checklist verified at site.		
2	Copy of specialist HDD contractors and NDRC consultants signed inspection document for “OK to proceed” is available at site?		
3	MSRA has cross checked and confirmed for completeness?		
4	Drilling machine and tracking device are matching with approved NOC submission.		
5	Drilling and Tracking Operators qualification has been verified by the NDRC Consultant		
6	A copy of DUSUP verified TP records available at site?		
7	Approved drawings including crossing profile are available at site?		
8	MSRA has cross checked and confirmed for completeness?		
9	Utility Owners NOC (if applicable) is available at site?		
10	Horizontal distance between edge of entry/exit pit to edge of existing pipeline is as per approved drawing?		
11	Surface coil is surveyed, and location coordinates updated in RivCross system.		
12	Elevation and coordinates at entry point (zero chainage) and exit point is recorded as per DM Benchmark?		
13	Verified existing utility locations are marked at site?		
14	Bore centreline is marked at site?		
15	Wireline system is tested before commencement?		
16	Tracking of pilot is recorded at each drill rod ends, crossing locations and 5m either side of crossing		
17	Witness vertical separation on Section view of the tracking window in Operator cabin.		
18	Availability of approved minimum vertical separation of pilot drill is verified and confirmed before reaming activities.		

NOC NUMBER		LOCATION	
NO.	**DESCRIPTIONS**	**Y/N**	**COMMENT**
19	Observation pit (if utilitsed) is backfilled & compacted, and berm reinstated to the original condition?		
20	If Frac-out / settlement issue is observed along the drilling route or within the observation pit, NDRC consultant assessment is carried out and action plan is agreed with NOC engineer.		
21	Brief HDD contractor on XYZ mapping preparation requirements?		
22	Contingency plan is available in case of equipment failure?		
23	Restoration work at entry and exit pit (in close proximity of DUSUP corridor) is satisfactory?		

ATTACHMENT 11 - HORIZONTAL DIRECTION DRILLING – TRACKING TOOLS

With the HDD drilling head move deeps underground, a locator is required to track the drilling, and there are three basic kinds to choose from. The selection of tracking device is based on what is right for a particular job. The technology ranges from basic to advanced, allowing for differences in how deep and far one can drill and still communicate with the drill head from the surface.

Three types of tracking tool are typically used:

- Walkover tracking device
- Magnetic Wireline Steering Tools
- Gyro Steering Tools

Regardless of type, nearly every HDD locating system consists of three parts - transmitter, receiver, and display. Each variety's abilities and complexity are key parts of choosing the right one for a particular job.

Transmitter

Located just behind the drill head, a sonde transmitter is a slender tube about 15 inches long that collects and relay's location information. Knowing the data strength and signal strength allows the operator to calculate the drill bit's clock position -which way it is pointing - the depth of the bit in the bore.

Falcon F5 Wideband Transmitter with Fluid Pressure

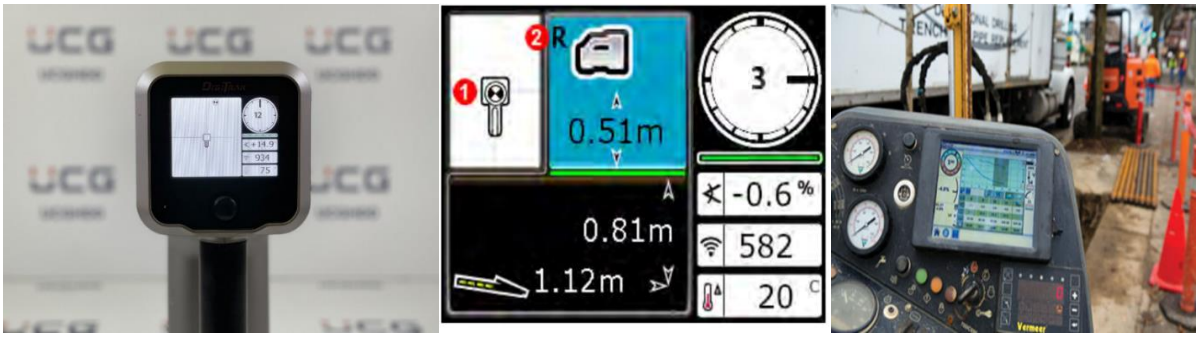
Receiver

A receiver is a handheld unit that receives the data the transmitter sends. The operator - sometimes called the locator - holds the unit near the drill head's bore location. The receiver is moved along with the head and transmitter to gather real-time location information continuously.

Display

The receiver's screen is the display, which shows the data the receiver gets from the transmitter. It allows the operator to see the drill's location and orientation to know if things are going according to the bore plan.

The operator can use the display to adjust the drill head's pitch, direction, and depth to correct any drift from the planned path.

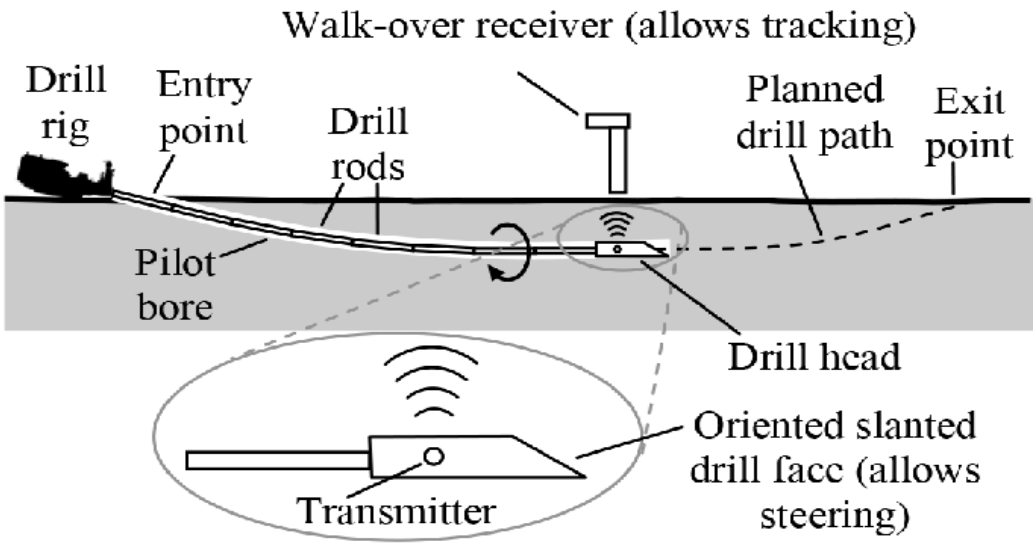


Walkover Tracking Device

In Walkover tracking system, a small radio/sonde transmitter in the drilling head transmits information about the location and orientation of the drill bits slanted face to a crew member who walks directly above the drill head with a handheld receiving unit. Information is displayed on a screen at the top of the receiver and to a remote display at the drill machine's operator station and provides information necessary for the driller to change direction of the bore. The drill operator makes steering adjustments by stopping rotation of the drill string, positioning the face of the bit, and pushing the bit forward.

As it uses an electromagnetic signal to relay data, it is best in locations where there are not many obstructions to block the signal i.e. concrete blocks / underground voltage cables.

Walk-overs are efficient for shallow bores and easy to set up. The more advanced versions give real-time remote guidance and can work on multiple frequencies. However, they are limited by the depth at which they can drill and the amount of interference they can overcome.



Magnetic Guidance Systems- Wireline Tracking

Magnetic guidance systems use some form of sensing device to determine the location of the drill bit within either the earth's or an artificially generated electromagnetic field.

In HDD terms - a "wireline" is a strand of insulated copper wire that is threaded through the inside of the drill string to the locating tools in the downhole assembly (right behind the drill bit). At the surface,

the wireline connects to a power supply and/or a computer at the rig. The wireline runs inside of the drill pipe so every time a rod is added to the drill string, another length of wire is spliced into the wireline connection. The connection is crimped in place and covered in heat-shrink tubing to prevent short circuits. This wire may just supply power to a locating unit and / or it may also carry a data stream back to instrumentation at the rig.

There are two types of wireline system:

a) Combination of wireline and walkover tracking:

Where more power is needed to generate a stronger electromagnetic field, either to provide deeper locates or to overcome interference, the sonde may also be powered through a wireline. Wireline powered systems can extend walkover system usability to perhaps 100 foot in depth, depending on conditions.

b) Remote tracking (e.g., Paratrack 2)

Deeper than 100 feet, or in areas of significant interference, it is necessary to turn to different technologies. More advanced magnetic guidance systems reverse the locations of sensors and magnetic fields. Instead of generating a magnetic field downhole with the sonde and sensing it at the surface, the sensor is put down the hole and is linked to the surface via a wireline that conducts both power and data. The sensor then can determine an azimuth direction based on the earth's magnetic field.

However, the earth's geomagnetic field is variable from place to place and can be distorted by strong electrical fields associated with power lines, industrial applications, or even by large masses of metal, like pipelines, ore bodies or slag piles, landfill debris, or reinforced concrete - the types of things often found around environmental sites. To counteract this variability, most non-walkover magnetic systems employ an artificial magnetic field to make the locating more precise. This is generated by laying a temporary coil on the ground surface with a loop of insulated wire that encircles the bore path. Many contractors or consultants are referring to this type of system as "wireline" systems. However, since these systems do not require a technician to follow the bore path with a locating device, this system may be considered as a "remote" operated wireline system (e.g., Paratrack2). In remote operated system, the tool and tracking system relay information to the driller's console, and the interface unit allows the operator to control the drill accurately.

This type of locating system is more costly and time-consuming to implement.

Pro's

- The magnetic steering technique is an accurate method of steering HDD. Unlike gyros, magnetic is not as sensitive to shock or vibration that can occur when breaking up rocks, which may be in the way.
- Because there is an on-surface tracking tool, magnetic steering is often referred to as more accurate than its gyro steering counterpart. Some magnetic steering tools do not require surface tracking coils, but they make them more accurate.

Con's

- The main disadvantage of using remote magnetic steering in HDD is the coil-based guidance system. there are times when there is no place to put the coils i.e. across busy roads.
- A strong enough magnetic field from say a power station makes it difficult for the sensor in the ground to accurately find the coils sitting on the ground surface.

- The steering tool cannot read through casings, which are often used in gas and oilfield drillings.

Gyro Steering Tool

This locator type gives one of the most accurate readings because it is not susceptible to magnetic interference. It relays accurate navigation information from the drill head to the operator in real-time without the effect of external influences. The downhole unit measures the position of the steering tool in real time ("Measurement-whilst-drilling"). This information, combined with the drilled length to calculate the displacement allowing the tool to be accurately steered over the envisaged bore path.

Pro's

- Gyro steering does not need or use magnetic fields for orientation and therefore are unaffected by potential interference from the surrounding area.
- As it is not affected by magnetic interference, there is no need for a non-magnetic spacing collar. The gyro steering tool can run closer to the bit and is placed behind the jetting assembly to provide accurate real-time readings and shorter setup times.
- The gyro steering is not affected by magnetic interference therefore better suited for jobs requiring casings.
- It works well over long distances, and does not rely on walk over devices and or coil on the surface of the drill route.

Con's

- There are indications that gyros, while accurate and responsive, can deviate from the track easily.
- The lack of external sensors makes it difficult to ensure that the drill is on track to make corrections.