Section 3: Project Description

3.0 Project Description

3.1 INTRODUCTION

The route of pipeline starts from the existed valve room of El-Tena East site (long. 31° 01' 27.74" lat. 32° 20' 39.3") heads south for a distance of 400 m. then turn east crossing El-Qantar - Port Foad Road., and continue parallel to El-Sheikh Gaber Canal from the west bank in the vicinity of canal parallel to the High voltage towers in the safe zone, to reach El-Qantar – El-Areish road, where the proposed pipeline will extend parallel to the road from North side in the back area of Roman village to be connected to Roman compressing station (long. 31° 01' 23.9" lat. 32° 40' 06.3") (End point of Loop 1, "from KM 0.00 to KM 33.00")

Loop 2 starts from the existed valve room no 4 of the existed pipeline 36" at Bair El-Abd (long. 31° 00' 11.6" lat. 33° 03' 18.4") , where the pipeline heads to the East direction to El-Areish parallel to the existed 36" pipeline with a distance about 10 m and parallel to El-Qantar El-Areish. About 3 KM from the south site crossing paved road at El-Midan village, and crossing the low voltage lines continues parallel to El-Qantar El-Areish road, crossing number of farms for a distance about 2 KM , then crossing the Airport road heads to End point At El-Areish (long. 31° 05' 43.9" lat. 33° 50' 36.1") with a total distance of 78 KM End of Loop 2.

The purpose of duplication of the existed pipeline Abr Sinai, by construction of Abr Sinai 36″, 111 KM pipeline is to increase gas manoeuvring along Sinai, increase efficiency of gas network in Sinai zone, and transport the produced Gas from El-Tena East to El-Areish Industrial area.

The pipeline shall be designed, constructed and tested in general accordance with ASME 31.8 and relevant EGAS/GASCO codes and standards. Thus, it will be free from significant defects.

Its continued fitness for purpose requires that it shall be operated in accordance with ASME 31.8, ***EGAS***/***GASCO*** relevant codes and standards and specific factors. One of the main factors is that it is protected against corrosion.

3.2. DESIGN

A pipeline which has been designed constructed and tested in general accordance with ASME 31.8 and relevant ***EGAS***/***GASCO*** codes and standards will be free from significant defects. Its continued fitness for purpose requires that it shall be operated in accordance with ASME 31.8, ***EGAS***/***GASCO*** relevant codes and standards and specific factors given in a) to e) inclusive.

a) The pipeline is protected against corrosion.
b) The pipeline is protected against external interference.
c) The pipeline is not adversely influenced by ground movement, from natural or man made causes (e.g. geological faults and mining).
d) Modification, maintenance and repair of the pipeline is carried out in such a way that its integrity is preserved.
e) The pipeline is not adversely affected by fatigue.

The factors a) to d) above inclusive, routine inspection and preventive measures shall be implemented.

3.3. CODES AND STANDARDS

- API 5L For line pipes
- API 6D for valves
- ANSI B 16.9 and MSS SP 75 for fittings
- ANSI B 16.5 and MSS SP 44 for flanges
- ASME B 31.8 and ***EGAS***/***GASCO*** Local regulations for construction and pipeline design.

3.4. PIPELINE SPECIFICATION

Pipeline material: API 5L X60PSL2

3.5. GAS ANALYSIS & VOLUMETRIC RATES

The natural gas that is to be transported by the proposed pipeline was chemically analyzed for contents and the specification are summarized in the following table:

Table (3.1) Gas Specification

COMPONENT	RICH MOL%	LEAN MOL%
N_2	0.83	0.11
CO_2	3.44	0.1.
C_1	77.21	99.73
C_2	11.74	0.05
C_3	4.73	0.01
IC_4	0.76	0.00
NC_4	0.98	0.00
IC_5	0.16	0.00
NC_5	0.08	0.00
C_6+	0.08	0.00
TOTAL	100	100
GHV (BTU/SCF)	1176.59	1008.41
Specific Gravity (Air=1)	0.7251	0.5557

Gas volumetric rate along all sections: 40 million m3/day

3.6. TIME SCHEDULE

Generally, it is to be expected that working hours will be restricted to the daylight hours. The time schedule of the pipeline construction shall be as follows:

Table (3.2) Time Schedule of the Project

Activity Description	Start	Finish	Duration (days)
Duplication of Abr Sinai P/L 36" 111KM	01NOV07	31JUL09	**639**
ENGINEERING WORK			
SURVEY WORK	01NOV07	331MAR08	152
DESIGN AND SPECIFICATION	03NOV07	31AUG08	303
WORK PERMITS AND LAND COMPANSATION	11NOV07	31DEC08	417
PROCUREMENT WORK			
PROVIDING FUNDING	01NOV07		
1ST MRO FOR PIPES & BENDS	01DEC07		
TEND. & P.O. FOR PIPES & BENDS	01DEC07	31MAR08	122
1ST MRO FOR PIPELINESBULKSAND VALVES	01JAN08		
TEND. & P.O. FOR PIPELINE BULKS AND VALVES	01JAN08	30APR08	121
PIPES AND BENDS DELIVERY	01AUG08	31OCT08	92
PIPELINE BULKS AND VALVES DLIVERY	01NOV08	28FEB09	120
CONSTRUCTION WORK			
PIPELINE COATING	15SEP08	15DEC08	92
CONSTRUCTION WORK	01OCT08	30JUN09	173
HYDROTESTING	01JUN09	31JUL09	61
MECHANICAL COMPLETION		31JUL09	

Section 3: Project Description

3.7. NUMBER OF CASUALS, LABOURS AND ENGINEERS WORKING IN THE PROJECT

Table (3.3) Number of casuals, labours and engineers working in the project

S	Title	Qty.	S	Title	Qty.
1	Project Manager	**1**	2	Civil Forman	**2**
3	Project Engineer	**2**	4	Surveyor	**3**
5	Technical Office Engineer	**2**	6	H.S.E Forman	**3**
7	Managerial Supervisor	**1**	8	Welders Forman	**2**
9	Director	**2**	10	Riggers Forman	**2**
11	Accountant	**1**	12	Welder	**30**
13	Doctor	**1**	14	X-Ray Technician	**10**
15	Wear House Keeper	**2**	16	Fitters Forman	**1**
17	Photographer	**1**	18	S.P Technician	**2**
19	Mail Boy	**1**	20	Coating Technician	**4**
21	Purchaser	**1**	22	Transportation Form	**2**
23	Security	**2**	24	Car Driver	**6**
25	Radio	**1**	26	Pick Up Driver	**8**
27	Pick-up Driver	**10**	28	Equipment Forman	**1**
29	House Keeper	**4**	30	Heavy Gear Driver	**29**
31	Photographer	**1**	32	Light Gear Driver	**13**
33	Buffet Boy	**3**	34	Maintenance Engineer	**3**
35	Chef	**4**	36	Maintenance Forman	**2**
37	Carpenter	**1**	38	Equipments Technician	**10**
39	Plumber	**1**	40	Equipment Electrician	**7**
41	Guard	**5**	42	Pipes Fitter	**5**
43	Electrician	**1**	44	Fitting Electrician	**5**
45	Assistant Chef	**4**	46	Assistant Surveyor	**2**
47	Waiter	**4**	48	Drawer	**1**
49	Executive Manager	**1**	50	Grinder	**35**
51	Civil Engineer	**3**	52	Rigger	**24**
53	Mechanical Engineer	**4**	54	Fire Fighter	**4**
55	Q.C Engineer	**4**	56	Tire Worker	**1**
57	H.S.E Engineer	**1**	58	Grease Worker	**1**
59	Survey Engineer	**1**	60	Power Electrician	**4**
61	Painting Engineer	**1**	62	C.P Engineer	**1**

**** Note:** The residence of project stuff will be at El-Areish City*

3.8. TYPES & NUMBER OF EQUIPMENTS USED DURING CONSTRUCTION

Table (3.4) Types & number of equipments used during the construction phase

S	Equipment	Qty.
1	Double Cabin Car	5
2	Double Cabin Car 4*4	8
3	Pick Up	4
4	Bus (26 Persons)	6
5	Puller	5
6	Generator 200-250 K.V	5
7	Crane 50 Ton.	3
8	Side Boom D8	13
9	Pipe Welder	4
10	Pipe Carrier	2
11	Welding Machine	37
12	Low Bed	3
13	Water Tank Car	5
14	Solar Tank Car	2
15	Agriculture Excavator	5
16	Truck	6
17	Excavator	6
18	Loader	4
19	Bulldozer D8	3
20	Trailer	4
21	Compressor	5
22	Sand Plaster	5
23	Cement Mixer	2
24	Boom Excavator	2
25	Ambulance	1
26	Compression Pump	2
27	Filling Pump	2

28	Handling Pump	2
29	Test Compressor	2

3.9. CONSTRUCTION

Construction will be carried out by qualified and approved contractors under the supervisions and monitoring of ***GASCO/EGAS*** personals.

The work will broadly be split into the following phases:

- Right of Way.
- Pipe storage and stringing of pipe.
- Trenching.
- Welding and weld inspection.
- Wrapping of joints.
- Visual wrap inspection.
- Holiday Detection
- Air tests.
- Ditching.
- Installation of valves.
- Tie-ins including valve installations etc.
- Backfilling.
- Cleaning.
- Gauging Pig.
- Hydro test.
- Additional air test.
- Dewatering.
- Magnetic cleaning pig.
- Geometric pig.
- Drying & commissioning.

3.9.1. R.O.W.

The Company and Contractor will manage access to the construction areas through permits. The Company is responsible for providing permits and documents etc. for access to the Right of Way for the construction of the pipeline and all crossings. Clearing the R.O.W. and preparing it for the construction work shall be done by the Contractor at his own expense.

The Contractor shall ensure that they have written clearance form the Company's Archaeologist indicating the location of any suspected remains/relics before commencing excavation.

The Contractor shall avoid undue damage to crops, trees, roads and properties on the Right of Way. The Contractor is responsible for all damages to crops, buildings, installations and properties adjacent to the Right of Way which may occur, however caused, due to the construction works. Any expenses for such damages shall be borne by the Contractor.

Where any irrigation or drainage installations (Canals, ditches, etc.) are encountered on the Right of Way the Contractor shall provide and install temporary connections so as to avoid interruption of, or variation in the required flow of water. This will be to the satisfaction of the authority in control of the waterways. The Contractor shall as soon as possible construct or reinstate to the original condition and the satisfaction of the Company, all structures and installations connected with irrigation which have previously been disturbed by the works.

The Contractor shall prepare the Right of Way in a manner allowing ditching, stringing and laying of the pipeline correctly without injuring pipe coating, or endangering human life.

The Contractor shall maintain the necessary day and night warning signs to protect persons, automotive vehicles…etc. The Contractor shall provide night watchmen at known crossing points of the pipeline and at all other areas where items of value are stored.

3.9.2. MATERIALS AND EQUIPMENT STORAGE

The storage location of materials and equipment will be at KM 55 (almost half distance).

3.9.3. TRENCHING AND EXCAVATION ACTIVITIES

The contractor shall excavate and maintain the trench in which the pipeline is to be laid exactly along the marked route as established by the survey and not less than the following dimensions with + 10% where required by works in some areas:

Depth to the pipe top elevation below the ground level:

- lm for all types of land other than rocky area.
- 0.7m for rocky areas.
- Width of trench D+O.4m (where D is the outer diameter of pipe with coating).

For Abr Sinai Pipeline 36" 111Km: expected 330.000 m3 of desert land sand.

The Contractor may only deviate from the marked line with the written permission of the Company.

The ditch bottom shall be uniformly graded and free from coarse rocks or gravel or any similar bodies which could injure the pipeline coating.

3.9.4. PIPELINE LAYING TECHNIQUE

Pipe is not laid in a stressed condition; lowering operation shall be undertaken in such a manner to minimize induced stresses due to construction procedures, due consideration shall be given to the timing of these operation with respect to maximum and minimum ambient temperature and ASME B 31.8 the trench shall be maintained in dry conditions during lowering and back filling operation.

The following steps must be followed:

1) Three side booms shall be used for the lowering in operation.
2) Side booms shall work from the R.O.W side of the trench and to be positioned 15m apart and 3m from the trench centre line.
3) The portion of pipe line between trench and the bank shall be supported by side booms holding the line in a gentle 'S' curve.
4) The vertical and horizontal alignment of the pipe shall conform to the contour of the trench and there shall be no undue sag, twist or bend.
5) The 1st side boom shall position its boom over the trench centreline with the 2nd and 3rd side booms positioning their booms to suit.
6) The 1st side boom shall lower the line into the trench carefully, the 2nd and 3rd side booms shall lower in sequence to maintain a smooth line 'S' curve.
7) When the 1st side boom has completed lowering the pipeline, riggers shall unhook the sling and the 1st side boom shall move 15m beyond the 3rd side boom and hook-up the sling to its new position.
8) The sequence (5, 6&7) shall be repeated with the 2nd and 3rd side booms as the line is lowered and the side boom advance in sequence along the pipeline.

9) The lowering-in Forman shall be the person with sole responsibility for controlling the movement of the equipment.

3.9.5. DITCHING

The Contractor shall excavate and maintain the trench in which the pipeline is to be laid exactly along the marked route as established by the survey and not less than the following dimensions with + 10% where required by works in some areas

Depth to the pipe top elevation below the general ground level

1 m for all types of land other than rocky area

0.7 m for rocky areas.

Width of trench

D + 0.4 m

Where D is the outer diameter of pipe with coating.

Angle of trench

Rocky area- vertically cut

Desert areas:

Compacted sand - 40° to vertical

Running sand - 70° to vertical

(see figure 3.1. shows ditching sketches for different soil types)

Section 3: Project Description

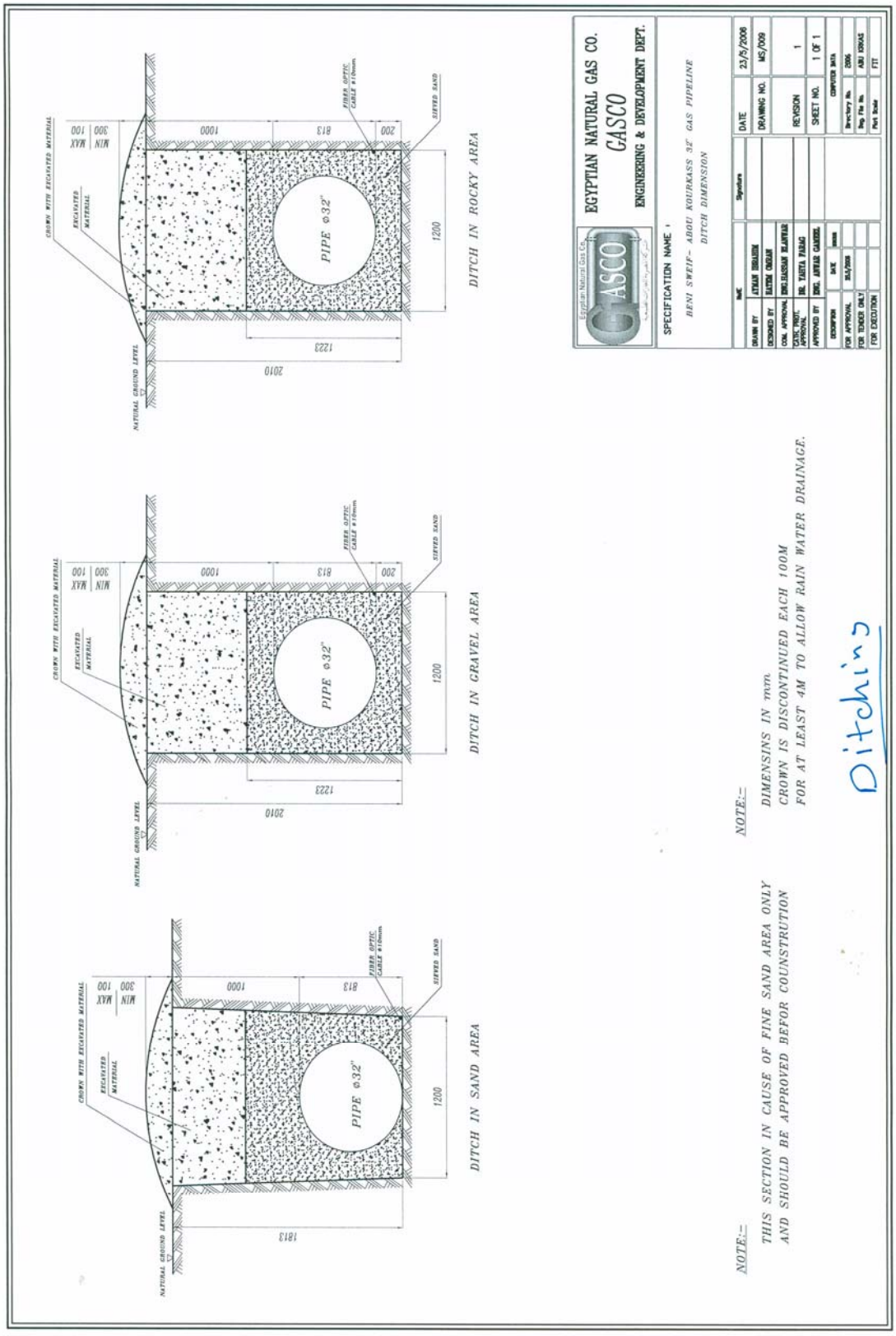


Figure (3.1.) "Ditching sketches for different soil types"

The ditch bottom shall be uniformly graded and free from coarse rocks or grave or any similar bodies which could injure the pipeline coating.

At locations with irregular ground elevations (contours) additional excavation may be necessary to eliminate undue bending of the pipe.

Where the route of the pipeline crosses with other underground utility lines, the trench shall be deepened. The pipeline shall be installed below or above existing lines or cables in accordance with drawings approved by the company. ***(see figure 3.2. & 3.3.)***

Procedures and minimum clearances are given in Local Regulation L.R.l.6.5.C&S Proximity of GASCO Gas Business Pipelines to Other Services, must be followed.

Where the route of the pipeline crosses roads, the requirements specified in Local Regulations L.R 1.6 C&S – Road crossing, must be followed.

Section 3: Project Description

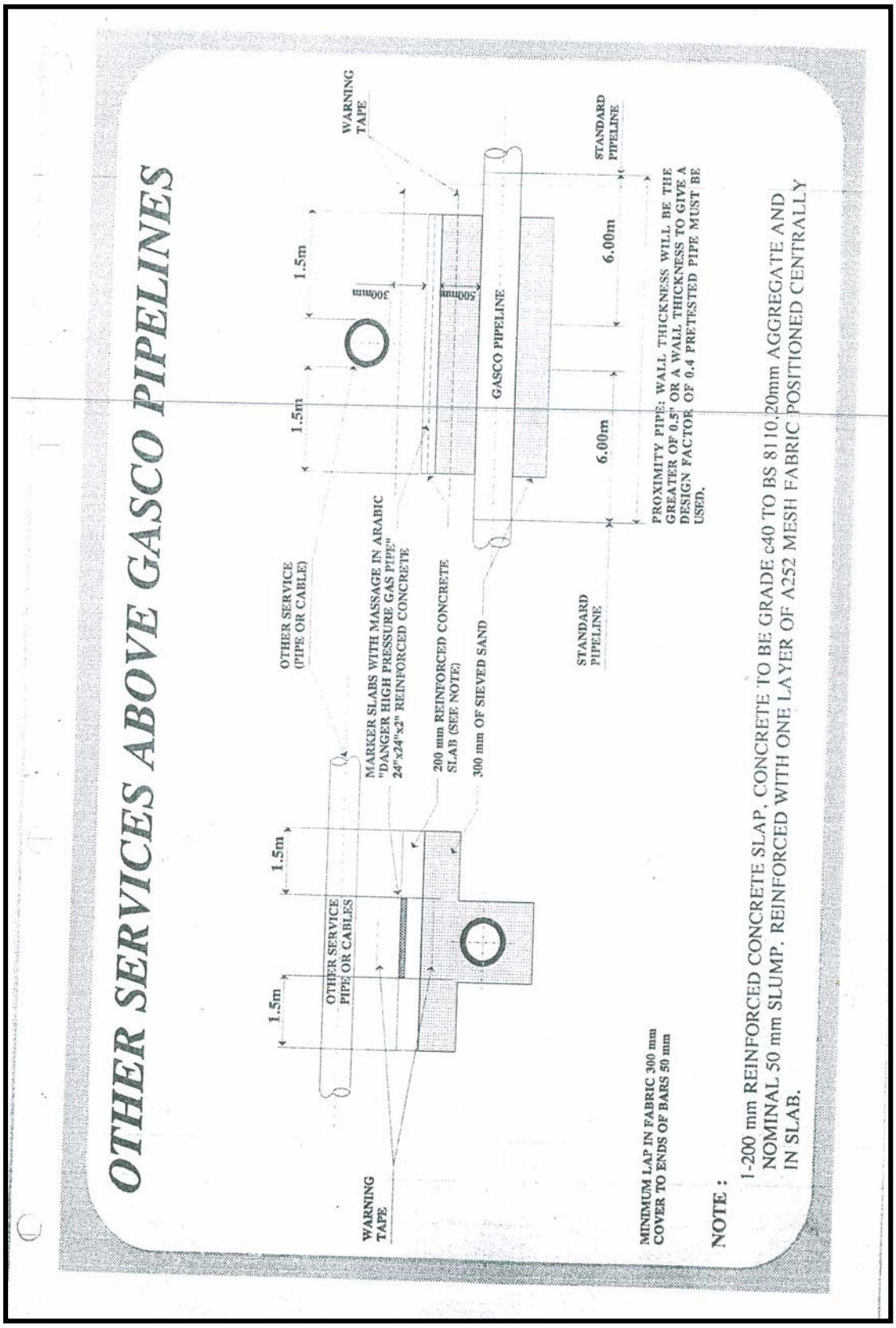


Figure (3.2.) "Crossing other services above GASCO Pipelines"

Section 3: Project Description

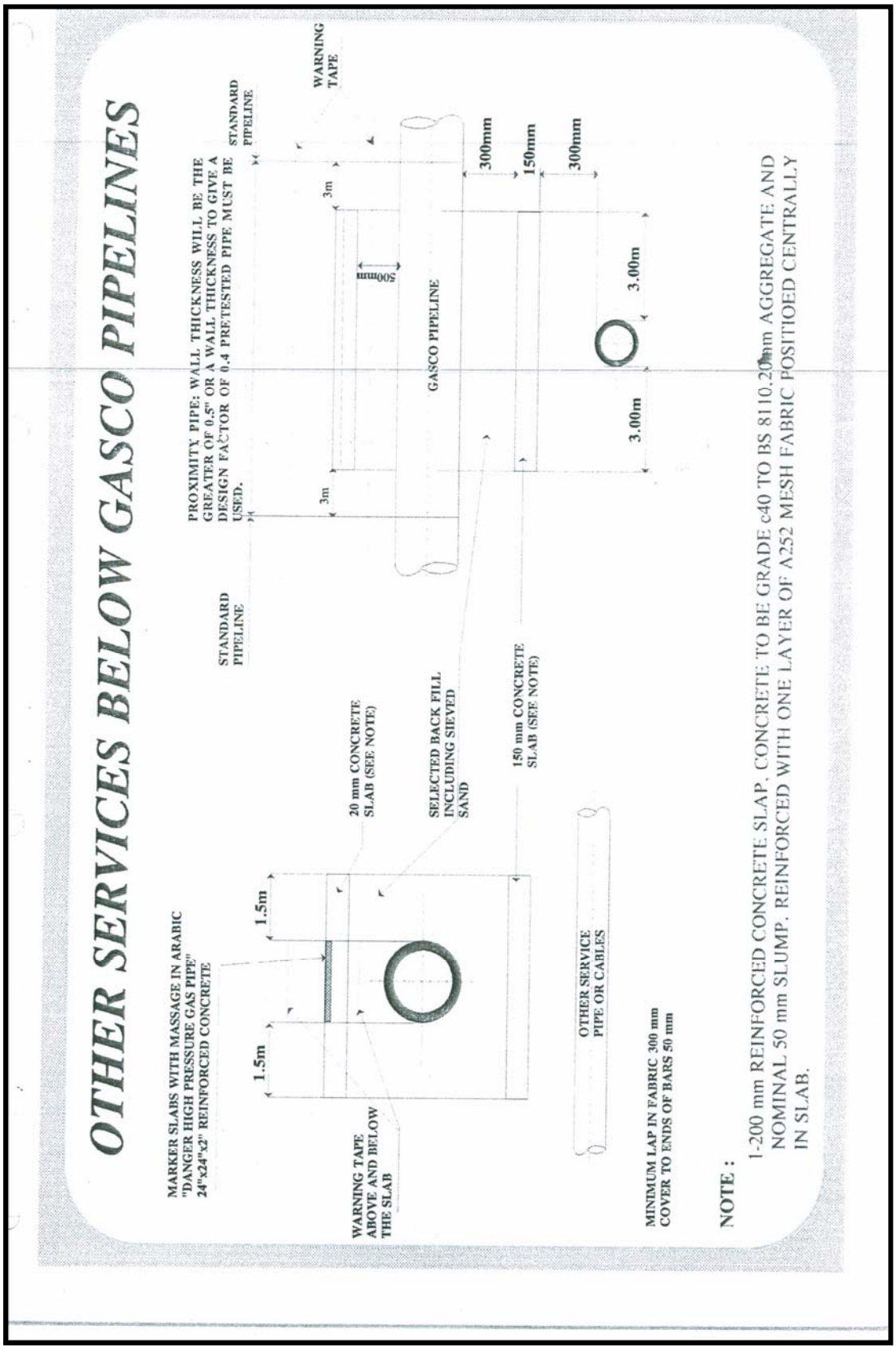


Figure (3.3.) "Crossing other services below GASCO Pipelines"

3.9.6. LOWERING AND BACKFILLING OF A PIPELINE

Lowering of pipeline shall only be carried out following a successful test of the whole of the coating by the holiday detector and insuring that the testing is 100% passed (voltage according to the coating specifications) and free from damage or any pinholes. The certification will be issued and signed by the contractor to confirm a satisfactory test.

The bottom of the trench must be cleaned of any rocks, stones or hard objects. The trench shall be padded with a minimum of 20 cm of sieved sand.

Wide non abrasive belts shall be used in all lowering operations and care shall be taken when removing the belts from around the coated pipe. Any damage caused to the pipe coating during the lowering operation shall be repaired before lowering the pipe in the ditch.

No lowering operations shall be undertaken except in the presence of the company or their representative. During this operation special care shall be taken to ensure; that the pipe coating sustains no damage and that the pipe is not laid in a stressed condition.

Lowering operations shall be under taken in such a manner to minimise induced stresses due to construction procedures. Due consideration shall be given to the

Company who must be satisfied that the pipe is evenly, bedded throughout its length upon the bottom of the trench and is not riding upon stones or other objects etc.

The trench shall be backfilled within 48 hours after lowering of pipe. Initial backfill will be to a minimum height 20 cm. of sieved sand. The trench shall be clear of any rocks stones or hard objects, the trench shall be padded with 20 cm of sieved sand. Above and around the pipe a minimum of 20 cm sieved sand backfill must be compacted around the pipe to provide protection from the remainder of the backfill. The backfill will be thoroughly compacted by wet tamping in 15 cm layers.

The backfill shall normally be crowned to a height of not less than 20 cm. above the adjacent ground level.

Backfilling of trenches through roads shall be carried out immediately after the pipe has been laid and with material as above. The backfill shall be compacted in layers not exceeding 15 cm and finished level with the road surface. The road surface shall be finally restored to the same condition as before work started.

Backfilling of crossings must take place immediately after the pipe has been laid and tested. The trench shall be clear of any rocks stones or hard objects, the trench Shall be padded with a minimum of 20 cm of sieved sand.

Above and around the pipe a minimum of 20 cm sieved sand backfill must be compacted around the pipe to provide protection from the remainder of the backfill. The backfill will be thoroughly compacted by wet tamping in 15 cm layers.

3.9.7. PIGGING METHODS

contractor shall clean, gauge, and repair the pipeline after construction immediately. Clean water will be the test medium.

3.9.8. CLEANING FLUSHING AND GAUGING

- The pipeline shall be swabbed six times with air driven foam bodied pigs or rubber cupped bi-directional pigs until it become clean of foreign material, then cleaned with clean water at a flow rate determined by the company for 24 hours, at least, it shall then immediately be gauged with an air driven gauge pig, fitted with an aluminium gauging plate having a diameter equal to 95% of the internal diameter of the pipe for above 300mm and 90% for 300mm and below, temporary scraper station shall be supplied by contractor for stage testing.

The discharge will be:

- A) small amount of dust from cleaning and will be disposed to industrial dump.
- B) Water from flushing and will be disposed to industrial drain sewage.

3.9.9. HYDROSTATIC TESTING

- Water shall be clean fresh water and free from any substance which may be harmful to pipe material.
- Fitter of sufficient capacity to accommodate the filling capacity of the pumps shall be installed between the water source and the suction flange of the pump and shall be kept in good order all the time of the operations (mesh 20). Static pressure will be maintained by the lines for 24 hours with no unexplainable drop in pressure for test to be acceptable.
- A pressure recording instrument shall be connected to the pipeline for the duration of the test.

- Hydrostatic testing must be followed by dewatering and gauging, the pipeline must not be left water in it.
- The pipeline will be tested in two sections; the water used in the first section will be tested to show the possibility of using it in the second section.
- Environmental friendly corrosion inhibitors chemicals will be used ***(please revert to MSDS – appendix 6).***
- The steps of the hydrostatic test are as following:
  - A 'by direction' is placed in the beginning of the pipeline before water flushing.
  - The pipeline is filled with fresh clean water by use of pumps. Filters are placed between the pumps and the pipeline to remove any contaminants to enter to the pipeline.
  - The by direction is moving in the entering water inside the pipeline to guarantee the emptiness of the pipeline from air.
  - The by direction comes out from the receiver trap.
  - Assure that there are no 'air pockets' inside the valve rooms.
  - The pressure is raised inside the pipeline till reaching 50% of the required pressure for the test; for example: if the required pressure is 105 bar, then the pressure is raised to 52.5 bar.
  - The pressure is stopped for 12 hours. Patrolling on the pipeline and the valve rooms to ensure the absence of any leakage.
  - After 12 hours, the pressure is raised again till reaching to 105 bar.

- The pressure is for 24 hours observed and recorded on a chart recorded.
- After checking and being sure that the pressure is stable for 24 hours, the pressure is lowered to 0 bars.
- The receiver trap is opened again and the 'by direction' is placed for sweeping the water.
- The pipes are internally coated with anti-corrosion substances that don't be affected by the pigging.
- The test duration is short; 24 hours, then the pipelines is emptied of the water after.

The water that will be used in this test shall be taken on the two parts from El-Salam canal for Loop#1 and from Mediterranean Sea in Al-Areish area for Loop#2, and the generated effluent shall be gradually discharged to the same source. The total estimated quantities of water are 92955 m3. About 27635 m3 of El-Salam canal water, and About 65320 m3 of sea water from Mediterranean sea And the chemical anticorrosion that will be used in the second loop are environmentally friendly, and there is no chemical or additives will be used in the first Loop

Sampling and analysis for the wastewater before discharging shall be done versus the limits passed in Laws 48/82 and 4/94. (refer to section #2 "Water Pollution").

3.9.10. DEWATERING

- Dewatering will follow immediately upon completion of a satisfactory hydrostatic test the pipeline must not be left with water in it.
- As a minimum this procedure will be based upon the use of foam bodied pigs or rubber cupped bi-direction pigs.

- Pigs will be run until there is no evidence of water in the pipeline as determined by the company.
- Test for water shall include assessment of the gain in weight of any foam pig or measuring of the dew point of the compressed air into and out of the pipe line.
- Measurement will take place before dewatering to complete arrangement with the responsible authorities.
- Dewatering will continue until the company's engineer is satisfied that pipeline is free from water within acceptance limit (Δ weight) is zero.

3.9.11. MAGNETIC CLEANING AND GEOMETRIC PIGGING

- A series of magnetic cleaning pigs will be run until the pipeline is judged by the company to be free of magnetic debris.
- After the pipeline has been cleaned by the magnetic cleaning pig the contractor will run a geometric pig. Acceptance of the pipeline will be based upon a successful report by this pig.
- Following a successful run by the geometric pig the pipeline will be left with positive pressure in it of at least 2 bar. The medium be with either dry air or dry nitrogen as determined by the company.

The discharge will be some metallic components and will be disposed to industrial dump.

3.9.12. DRYING AND COMMISSIONING

The pipeline will be dried by the application of either vacuum drying or by flashing with dry nitrogen at ambient temperature to ensure that no operational problems arise from water left in the pipeline

3.9.13. PIPELINE CROSSINGS
3.9.13.1. GENERAL

All pipeline crossings will be uncased unless otherwise specified by the company. Impact protection measures (cast in site or pre-cast concrete slab) shall be provided on all pipeline crossings. Warning tape shall be placed above and below such impact protection. Above ground pipeline crossings shall not be used in situation where alternative methods are possible. Horizontal directional drilling (HDD) techniques will be used for sensitive crossings and heavy traffic roads, open cut technique will be used for normal crossings.

Backfilling of crossings must take place immediately after the pipe has been laid. The trench shall be clear of any rocks stones or hard objects, the trench shall be padded with a minimum of 20 cm of sieved sand. Above and around the pipe a minimum of 20 cm sieved sand backfill must be compacted around the pipe to provide protection from the remainder of the backfill. The backfill will be thoroughly compacted by wet tamping in 15 cm layers.

The wall thickness shall be greater of 0.5 inch or a wall thickness to give a design factor of 0.4 with max. Wall thickness 0.75 inch providing that the design factor shall not exceed 0.5. Table (3.5) listed the crossings of Abr Sinai pipeline.

Table (3.5) List of Pipeline crossings

	Crossing name	Distance from start point	Coordinates		Type of Crossing
			N	E	
1	Port Foad – El-Tena road, Kilopatra drainage canal	431 m	***31° 01' 16.5"***	***32° 20.39.6"***	HDD
2	Irrigation branch canal No. 1 from El-Shikh Gaber and the road parallel to the Canal.	3.333 km	***31° 01' 14.8"***	***32° 22' 14.4"***	Open cut
3	None paved road	6.343 km	***31° 01' 17.1"***	***32° 23.5' 01"***	Open cut

4	Irrigation branch canal No. 3 from El-Shikh Gaber and the parallel road to the Canal.	8.13 km	***31° 01' 18.8"***	***32° 25' 23.4"***	Open cut
5	Irrigation branch canal No. 5 from El-Shikh Gaber and the road parallel to the Canal.	13.36 km	***31° 01' 22.7"***	***32° 23' 32.7"***	Open cut
6	Irrigation branch canal No. 7 from El-Shikh Gaber and the road parallel to the Canal.	17.803 km	***31° 01' 26.1"***	***32° 31' 32.2"***	Open cut
7	El-Farama Port-Foad Paved road.	23	***31° 01' 27.9"***	***32° 33' 07.6"***	HDD
8	Small Paved road	34 km	***31° 00' 11.5"***	***33° 07' 30.4"***	Open cut
9	Small Paved road (interance to Mazar village)	53 km	***31° 05' 25.9"***	***33° 45' 05.2"***	Open cut
10	El-Midan Village Paved road	64 km	***31° 04' 0.6"***	***33° 34' 53"***	HDD
11	El-Areish- Airport Paved road	79 km	***31° 05' 40.7"***	***33° 50' 11.3"***	HDD

Specific requirements for the various types of crossings are detailed below.

3.9.13.2. CASED CROSSINGS

Cased crossings shall not be used in situations where alternative methods are available. (Used in crossing which will be done by boring, … etc.)

All cased crossings will be carried out by thrust bore.

The coated pipeline shall be laid in either concrete or steel casings. This will be thrust bored in accordance with API and ASME standards plus any attached specification drawings. The casing should be extended 3 meter (min) from the end of crossing at both sides.

The inside of the casing should be cleaned before the pipe is pulled or pushed into place. Immediately after the pipe is in place where applicable casing and seals shall be installed.

Where the casing is steel the complete cased crossing shall have an electrical resistance between pipe and casing of more than 100 ohms before being tied in. if a lower resistance is measured, the pipe shall be removed from the casing, the insulation repaired and the pipe re-installed.

For a distance of 8 meters from each end of the casing the pipe shall have firm bearing on the bottom of the trench to prevent the pipe from settling. This may be accomplished by either compacting the bottom of the trench or by placing earth filled bags under the pipe at 1 meter intervals.

The distance between insulators shall be submitted by the contractor for approval by the company. This shall be in advance. They will be 0.5m from each end of the casing and then 1.5m apart.

The wall thickness shall be the greater of 0.5 inch or a wall thickness to give a design factor of 0.4 with max. Wall thickness 0.75 inch providing that the design factor shall not exceed 0.5.

3.9.13.3. UNDERGROUND CROSSINGS

The pipes shall be laid 1.5 meter below the lowest bed of the water course or road crossing.

The wall thickness for a coated pipeline for underground crossings should be the greater of 0.5 inch or a wall thickness to give a design factor of 0.4 with max. Wall thickness 0.75 inch providing that the design factor shall not exceed 0.5.

The pipe shall be laid with concrete slabs. The concrete slabs should be laid above the pipeline by distance of 50 cm, at least, to protect the pipeline from third party activities and to minimize the life loads on the pipeline.

The concrete slabs should be laid in contact with each other to be as one unit in distributing the load.

Backfilling for the crossing should be with well compacted sieved sand.

Concrete slabs should be prefabricated (precast) before lowering the slab in position.

For railway crossing ***GASCO*** prefer using horizontal directional drilling with the same condition in item 2.3.2 and the depth not less than 4m at any point under railway.

3.9.13.4. DRAINAGE AND CANAL CROSSINGS

Crossings may be constructed by open-cut, boring, directional drilling or tunnelling methods. Where open cut method is used the pipeline should be laid at a cover allowing for future bed movement and dredging operations or similar. Temporary flume pipes or other methods should be considered to ensure that there is no disruption of weight coating if required such as reinforced concrete to maintain negative buoyancy of the pipe both during construction and in service. Attention to be given to the integrity of flood or tidal barriers during construction and care to be taken to prevent pollution of water courses.

In all cases the minimum pipe wall thickness shall be 0.5 ins, or using a design factor of 0.4, which ever is greater.

Where a pipeline crosses water courses such as a ditch or stream, the pipeline should be located at such depth as will provide a minimum cover of 1 meter from the true cleaned bottom of the ditch or stream to the top pf the concrete pad or 2 meter of the adjoining field level.

3.9.13.5. NAVIGATIONAL CANAL CROSSINGS

Major submerged crossings shall be treated as follows:

- The wall thickness for pipe used for canal crossings shall be the greater of 0.5 inch or a wall thickness to give a design factor of 0.4 with max. Wall thickness 0.75 inch providing that the design factor shall not exceed 0.5.
- The pipes shall be laid 2.5 – 3 meters below the lowest bed of the water course and according to the irrigation authority approved.
- The trench shall be of sufficient width to lay the line of the crossings as shown on the drawing and shall be graded to ensure maximum support of the pipeline, immediately after laying the pipeline.
- The navigational canal crossing shall be crossed with concrete coated pipe.
- No cold bends shall be accepted under water.
- The Contractor shall submit to the Company for approval, the details of the method he intends to use in the crossing construction, the equipment to be used, calculations of maximum bending stresses, calculations of the loads, timing of operations and any information the company may require.
- ***GASCO*** prefer using horizontal directional drilling (HDD) with the same condition in 1st item and the depth not less than 4m at any point under water stream.

3.9.14. CORROSION CONTROL

The buried metallic structures (pipelines, valves) are coated and cathodically protected according to BS, 739, part 1 as all gas networks.

3.9.15. REINSTATEMENT OF THE RIGHT OF WAY AND SITE

As soon as the pipe is laid and backfilled, the Contractor shall reinstate and clean up the right-o-way.

All creeks, water courses, wells, siphons, drains, streams, ditches and irrigation channels shall be reinstated to their former condition and if necessary their banks shall be pitched with stone and/or faced with gabions to prevent washing out or erosion.

The stripped top soil shall be replaced carefully in position after the completion of the pipe laying operation.

All walls, fences, tracks, roads etc. shall be reinstated to their original condition.

Excess excavated material to be removed and disposed of in line with local regulations. Reinstatement shall be carried out within one week of backfilling of the section backfilled.

3.9.16. RUPTURE PROTECTION TECHNIQUE

Protection of pipelines at crossings is wholly dependent on the type of crossing. The following guidelines shall be applied:

3.9.16.1. GENERAL

With the exception of crossings done by Boring machines (railway, highway, etc.), all pipeline crossings with open cut shall be unsleeved. Impact protection measures such as cast in-situ or pre-cast concrete slabs shall be provided on all pipeline crossings as a minimum requirement.

3.9.16.2. UNDERGROUND

Backfilling of crossings must take place immediately after the pipe has been laid. The trench must be clear of any rocks, stones or other hard objects which could damage the external polyethylene coating. The trench shall be padded with a minimum of 20 cm of sieved sand also above and around the pipe a minimum of 20 cm of sieved sand backfill must be compacted to provide protection from the remaining backfill.

The back fill will be compacted by wet tamping in 15 cm layers. The pipe shall be laid and concrete slabs placed above the pipeline by a distance of 50 cm (minimum). Concrete slabs should be laid in concrete with each other to distribute external loads of backfill.

3.9.16.3. DRAINAGE AND SMALL CANALS < 4M WIDTH

No concrete or slabs required.

3.9.16.4. DRAINAGE AND CANALS > 4M WIDTH

Concrete slabs shall be used

3.9.16.5. NAVIGATION CANALS AND RIVERS CROSSINGS

Reinforced concrete coated pipe shall be used.

3.9.16.6. RAIL SLEEVE

Externally coated H.S. (High Strength) carbon steel sleeve pipe shall be used for protection

3.9.17. NUMBER OF LINES AT EACH CROSSING

Unless specifically called for to lay one or more other pipelines to reduce overall construction costs, all crossings shall be of a single pipeline only for the specific duty.

3.9.18. COVER OF PIPELINE

Cover of pipelines will be dependent on the type of crossings, the following guidelines shall be applied:

3.9.18.1. ROADS

Minimum cover to top of pipe shall be 1.5 meters

3.9.18.2. DRAINAGE AND SMALL CANALS < 4M WIDTH

Minimum cover of I meter from true cleaned bottom of ditch or stream.

3.9.18.3. DRAINAGE AND CANALS > 4M WIDTH

Minimum cover of 1.5 meters to top of pipe.

3.9.18.4. NAVIGATION CANALS AND RIVERS CROSSINGS

Concreted coated pipelines shall be laid 2.5 meters min. to 3 meters max. below the lowest bed of the water course.

3.9.18.5. RAIL SLEEVE

Minimum cover of sleeve to be at 1.5 meters below rail level.

SUITABLE WARNING TAPS SHALL BE PLACED ON ALL PIPELINES.

3.9.19. WATER BODIES CROSSING METHODOLOGY

Crossing of Water bodies and main canals in this project shall not be done by the traditional open-cut method. It shall be done using a new technology named *Horizontal Directional Drilling*.

Horizontal **D**irectional **D**rilling (HDD) is a trenchless methodology that provides an installation alternative that can offer a number of benefits over traditional open-cut. HDD can be implemented with very little disruption to surface activities, requires less working space, and may be performed more quickly than open-cut methods. Also, it can simplify or eliminate certain permitting processes. This type of installation which was applied in municipal underground infrastructure systems and petroleum products pipelines has seen a dramatic increase in recent years. Although there are currently no national standards regarding HDD installations for any pipe material, HDD pipeline installations are becoming more and more common and may be the fastest growing trenchless construction method today. They can be used to install new pipelines or replace existing ones.

The technique stages are illustrated in Fig. (3.1), which shows the operation in three stages, as follows:

Stage 1

The drilling rig and its associated equipment is set up and positioned on one side of the crossing. The carriage framework is inclined to the desired entry angle, which can be between 5° and 30°. Typically the entry angle is set between 10° and 14° to the horizontal.

An 80mm dia. Pilot hole is drilled using either a mud motor or a jet bit, attached to 73mm dia. Pilot drill pipe. The steering mechanism is provided by

means of a small bend or bent sub, usually less than 1° and situated behind the drill. Changes in direction are achieved by partial rotations of the bent sub, as the pilot string proceeds forward. Figure (3.1) gives a detail of the downhole drilling assemblies with mud motor and jet bit.

The progress of the pilot hole is monitored by a directional survey steering tool package. A survey probe is positioned just behind the drill head, which is linked by a hard wire up the center of the drill pipe to a computer and printer located in the control cab. The probe contains fluxgates and transducers which measure data in a three-dimensional plan by vector measurement, enabling the course of the pilot hole to be plotted joint by joint. Continuous read outs give the following information:

(a) Inclination relative to the vertical plane.
(b) Direction of hole relative to magnetic north, and.
(c) The orientation of the steering mechanism or bent sub relative to the high side of the hole.

The drilled distance is measured at the drilling rig by physically monitoring the down hole pipe lengths.

The readily available survey information, combined with the ability to steer and drill, allow the pilot hole to be drilled along the planned profile.

Progress or drilling speed depends on the suitability of the drilling medium.

As the pilot hole progresses the frictional force gradually increases on the 73mm dia. Pilot string and it then becomes necessary to wash-over the pilot string with 127mm dia. Washpipe. The front of the washpipe is fitted with a cutting bit, typically 300mm dia. And fitted with round 20 kennametal cutting teeth. Unlike the pilot string, the entire wash pipe rotates in moving forward.

In addition to reducing frictional forces the wash-over pipe increases the diameter of the drilled hole. It also serves to smoothen the curve and to eliminate any irregularities which may have occurred by use of the steering mechanism.

Stage 2

Drilling progresses with alternate drilling of pilot drill pipe followed by wash-pipe. The distance between the wash-over pipe cutting bit and the pilot drill bit will be in the range of 25.0 m to 80.0 m. It is not advisable to have wash-over pipe closer than 25.0 m as the proximity may adversely affect the accuracy of the survey tool. Alternate drilling continues until both the pilot string and wash-over pipe exit in the target area.

The pilot string is now removed from the system by pulling back to the drill rig, leaving the wash pipe in places as a drawstring for the pre-ream operation.

For the pre-ream operation a barrel reamer, fitted with jets and cutting teeth, is attached to the end of the wash pipe. The diameter of the pipe to be installed dictates the diameter of the barred reamer. Typically the diameter of the chosen reamer will be twice the diameter of the pipe to be installed. The barred reamer is rotated along the drilled path enlarging the formed annulus.

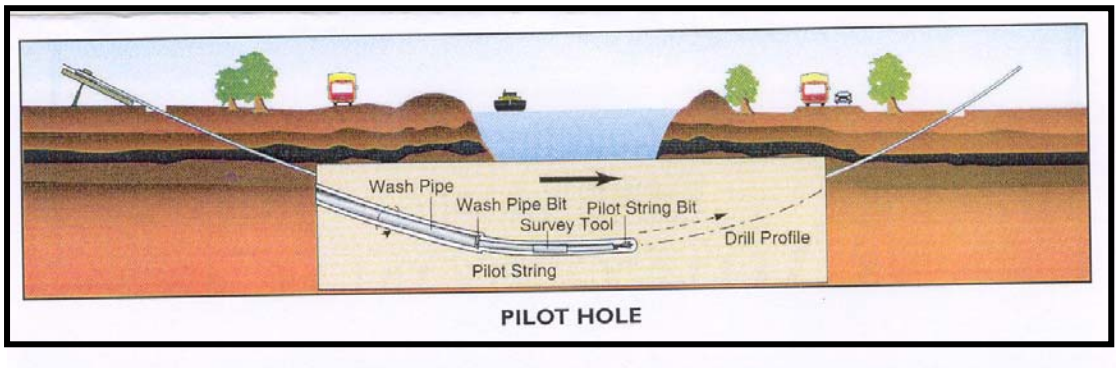
As the reamer is pulled back, additional lengths of 127mm drill pipe are added on behind, to ensure that a complete drill string remains in the hole for the next operation.

Stage 3

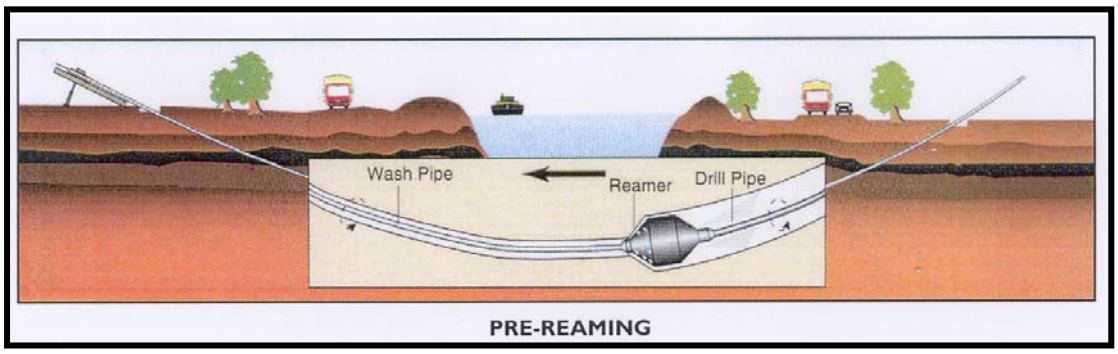
Either before or during the drilling operation, the pipeline has been fabricated on the target side of the crossing. On completion of hydrostatic testing, the pipeline fabrication is raised onto conveyors. A pulling head is welded onto the

front end of the fabrication. The reamer is then transported to the target area, i.e. the opposite side of the crossing. On completion of the pre-ream operation, the reamer is disconnected. The assembly for the pipeline insertion consists of the barrel reamer, followed by a universal joint, and a swivel to prevent rotation of the pipeline being installed. The reamer and pull head assembly are rotated and pulled back from the drill rig using the wash-over pipe. Accordingly a further reaming of the hole takes place as the pipeline is being inserted into the reamed hole.

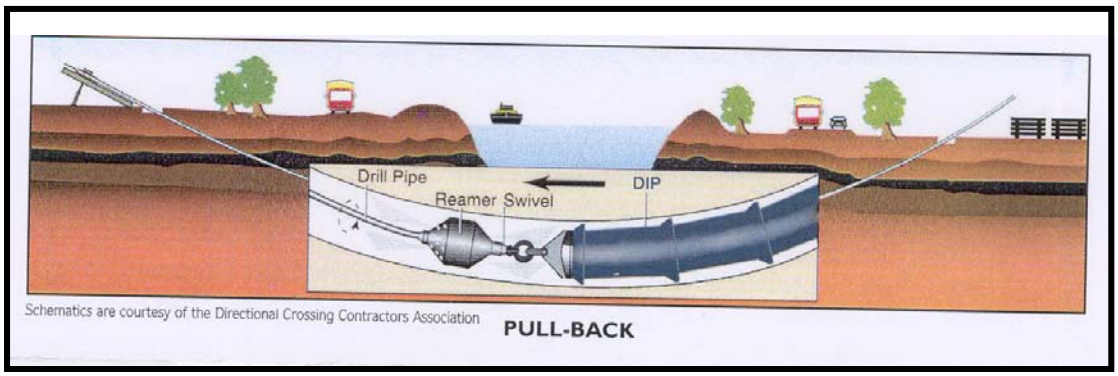
Section 3: Project Description



Stage (1)



Stage (2)



Stage (3)

Figure (3.1) Stages of the Horizontal Directional Drilling Technique (HDD)

3.9.20. METHODS OF PIPE TESTING
3.9.20.1. WELDING AND WELD INSPECTION

a) Welders qualification test.

b) Non destructive tests:

- Radiographic test (R.T. 100%)
- Ultrasonic test (U.T. 10%)
- Diepenetrant test for weldlet, sweepolet and nippolet (½", 1")

c) Destructive tests (Mechanical Test), includes:

- Tensile test
- Bending test
- Macro etching test
- Impact test
- Nick break test
- Hardness test

Every 200 weld joint we made this test (0.5% of all welds) in the laboratory of the faculty of engineering.

3.9.20.2. COATING

a) Pealing test (for weld joints coating).
b) Holiday detector test (for all pipe line coating).

3.9.20.3. PAINTING (VALVE ROOMS)

For measuring the quality and thickness of the layers of painting.

All the waste disposal of above mentioned tests will be handled with subcontractors certified for the job.

3.9.21. IMPACT PROTECTION

In normal circumstances, impact protection measures shall only be provided on pipeline crossings as required in the above mentioned Local Regulations, and the protection measures shall be undertaken as described in these Local Regulations.

The pipeline route would have been checked in accordance with criteria for population density proximity distances to buildings, roads, location classes .etc, as defined in Local Regulation L.R. 1.2. C&S - Design & Construction of Pipelines Proximity Criteria

Where it is not possible to meet this criteria, shall impact protection be designed to meet the requirement of Local Regulation L.R. 1.6.5. C&S.

3.9.22. SPECIFICATIONS FOR CATHODIC PROTECTION
3.9.22.1. DESIGN

After consideration of the options in proprietary designs available the type currently use by ***GASCO*** is generally satisfactory so this type shall continue to be used, but modifications to prevent loss of cover plates is recommended.

3.9.22.2. CABLING

Standardized cabling arrangements shall be used throughout the pipeline network.

3.9.22.3. LOCATION AND SPACING

Test points shall be located at spacing not generally exceeding 2 Km to both provide sufficient test points for routine monitoring and also to facilitate the carrying out of close interval potential surveys.

Test points shall be specified at:

a) Insulation Joints.
b) Sleeves.
c) Major crossings (e.g. roads, railways, canals and rivers).
d) Interference points (e.g. D.C. traction)

All tests facilities shall be accessible

3.9.22.4 REFERENCE NUMBERS

Each test point shall be given a unique reference number as per the cathodic protection schedule for the pipeline section.

3.10. OPERATION

It is important that GASCO should take all reasonable precautions to safeguard its pipeline and people living in the vicinity of its pipelines.

This code has been written to cover two specific areas of Pipeline Surveillance.

1) Pipeline Patrolling
2) Leakage Survey

3.10.1. PIPELINE PATROLLING

Pipeline Patrolling is carried out in order to identify activities or actions that could damage the pipeline. It also identifies areas of concern such as land slippage etc. in the general area of the pipeline that could cause subsequent problems. The frequency of the patrol will vary for differing areas. In desert regions there is minimal work carried out around the pipeline. In Urban areas where there is a lot of excavation activity on water mains, sewers, etc. and the frequency of inspection needs to be highest.

3.10.2. LEAKAGE SURVEY

Leakage Survey is carried out to protect the population and staff against the effects of escaping gas and detect damage to the pipeline. It is therefore carried out where the pipeline runs close to buildings and where staff work.

This Code is supported by Two Report Sheets one for each day of the survey for Patrolling Duties and one for Leakage Survey duties. These two sheets are designed to be the only documentation the operative needs to carry in the performance of the task.

The locations for both the Pipeline Patrolling and frequency and leakage survey must be determined in advance by a Responsible Engineer and reviewed at least annually.

All pipeline routes should be classified fully according to ASME 31.8 within 6 months of implementation of this code by a Responsible Engineer. This should also include those areas where regular leakage surveys will be carried out.

It is essential to take all reasonable precautions to reduce the risk of pipelines being struck or damaged. The inspection and surveillance, applied to a particular section of a pipeline, should reflect the likelihood of such damage at that location and the type of frequency levels should be regularly reviewed at intervals not exceeding two years.

All staff undertaking the Patrol duties and the leakage surveys must be fully trained before carrying out these duties.

Where the two surveys coincide in terms of frequency they can be combined into a Patrol and Leakage survey.

3.10.3. FREQUENCY OF PATROL

The Pipeline Patrolmen will carry out vehicle and walking surveys along the pipeline route, at the following frequencies:

Table (3.5)- Frequency of Patrol

PIPELINE LOCATION	VEHICULAR	WALKING
Location Class 1	6 Months	No survey
Location Class 2	1 Month Vehicular accessible areas in canal and lake crossings	6 Months Arable land, AGIs, valve rooms, crossings, sleeves
Location Class 3		2 Weeks Survey all areas
Location Class 4		2 Weeks Survey all areas

The Patrol will observe and report findings to the Sector Office on a daily basis and where the safety of the pipeline is at risk, notification will be as soon as possible.

The Patrol will be issued with written authorization to instruct other people, affecting the safety of GASCO property, to stop their work or actions immediately.

The Patrolman will need to complete a written Daily Report. These will be logged again on a daily basis, in the Area Office. These Daily Reports will be audited on a random basis by the Patrol's Supervisor.

The Survey Diary, issued to each Patrolman, will be completed by the end of each day. The Survey Diary will contain all observations along the pipeline route for a particular day. This Diary will be used as a check by the Patrol Supervisor.

All necessary Permits or permission will be obtained from landowners, farmers, railways, etc. prior to starting work. The Patrol will ensure that he holds a valid Identity Card or Letter of Authorization.

In addition to watching and reporting on the GASCO pipelines, the Patrol will establish a good liaison with farmers and landowners along the pipeline route.

It is not the intent to specifically test for the presence of leakage with gas detection equipment during this survey.

3.10.4. RECORDS & OPERATING MANUALS

The constructing contractor will be responsible for the production of all kinds of records relating to the whole construction job. These records include but not limited to:

(One) **Materials records** that contain identification number, inspection certificates, test certificates, etc.

(Two) **Welding records** (e.g. welder qualifications, welding procedure, etc.).

(Three) **Protective coating records** that contain date, method of cleaning, material used, repairs, etc.

(Four) **Painting records** (e.g. paint type, grade of paint, paint batch number,etc.)

(Five) **Mechanical installation records** (e.g. testing procedure, insulation procedure, pipe alignment, etc.)

(Six) **Structural steel work records** (e.g. line, level, plumbness, tightness of bolts, etc.)

In addition, Contractor shall supply all necessary maintenances manuals and training in their application.

3.10.4. VALVE ROOMS

The following table illustrates the valve rooms proposed to be constructed and their specifications.

Table (3.6)- Specifications of Valve Rooms

Room №	KM point	Location	Lat. (N)	Long. (E)
1	0+00	Start Point El- Tena East valve room (existed room)	***31° 01' 27.7"***	***32° 20' 39.3"***
2	00+33	Roman compressing station valve room (End point of LOOP#1)	***31° 01' 23.9"***	***32° 40' 06.3"***
3	00 +33	Start of LOOP #2 Bair El-Abd	***31° 00' 11.6"***	***33° 03' 18.4"***
4		Second trap valve room (existed room)	***31° 04' 0.6"***	***33° 34'53"***
5		Off take valve room front of El- Areish power station	***31° 05' 26.3"***	***33° 44'51.63"***
6	00+55	Valve room No# 6 (existed room)	***29° 39' 00.5"***	***32° 16' 29.0"***
7	00 +111	End point of LOOP#2 (East Gas Valve Room) (existed room)	***31° 05' 43.9"***	***33° 50' 36.1"***