أدنـوك
ADNOC

# ADNOC GROUP PROJECTS AND ENGINEERING

# ONSHORE PIPELINES DESIGN & CONSTRUCTION SPECIFICATION

## Specification

AGES-SP-10-003

ص ب 898، أبوظبي، الإمارات العربية المتحدة
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adnoc.ae

شركة بترول أبوظبي الوطنية
Abu Dhabi National Oil Company

## GROUP PROJECTS & ENGINEERING / PT&CS DIRECTORATE

| | |
|---|---|
| **CUSTODIAN** | Group Projects & Engineering / PT&CS |
| **ADNOC** | Specification applicable to ADNOC & ADNOC Group Companies |

Group Projects & Engineering is the owner of this Specification and responsible for its custody, maintenance and periodic update.

In addition, Group Projects & Engineering is responsible for communication and distribution of any changes to this Specification and its version control.

This specification will be reviewed and updated in case of any changes affecting the activities described in this document.

## INTER-RELATIONSHIPS AND STAKEHOLDERS

a) The following are inter-relationships for implementation of this Specification:

   i. ADNOC Upstream and ADNOC Downstream Directorates and

   ii. ADNOC Onshore, ADNOC Offshore, ADNOC Sour Gas, ADNOG Gas Processing. ADNOC LNG, ADNOC Refining, ADNOC Fertilisers, Borouge, Al Dhafra Petroleum, Al Yasat

b) The following are stakeholders for the purpose of this Specification:

   ADNOC PT&CS Directorate.

c) This Specification has been approved by the ADNOC PT&CS is to be implemented by each ADNOC Group company included above subject to and in accordance with their Delegation of Authority and other governance-related processes in order to ensure compliance

d) Each ADNOC Group company must establish/nominate a Technical Authority responsible for compliance with this Specification.

## DEFINED TERMS / ABBREVIATIONS / REFERENCES

"**ADNOC**" means Abu Dhabi National Oil Company.

"**ADNOC Group**" means ADNOC together with each company in which ADNOC, directly or indirectly, controls fifty percent (50%) or more of the share capital.

"**Approving Authority**" means the decision-making body or employee with the required authority to approve Policies & Procedures or any changes to it.

"**Business Line Directorates**" or "**BLD**" means a directorate of ADNOC which is responsible for one or more Group Companies reporting to, or operating within the same line of business as, such directorate.

"**Business Support Directorates and Functions**" or "**Non- BLD**" means all the ADNOC functions and the remaining directorates, which are not ADNOC Business Line Directorates.

"**CEO**" means chief executive officer.

"**Group Company**" means any company within the ADNOC Group other than ADNOC.

**"Specification"** means this Onshore Pipelines Design and Construction Specifica

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## I.1 SCOPE

I.1.1 This document defines the minimum set of requirements by ADNOC for the design and construction of onshore pipelines.

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I.1.3 The construction specification for above ground and buried pipelines are given in Section III.

I.1.4 This document replaces the following ADNOC Engineering Standards (ES);

1. 30-99-12-0032 (AON) Pipeline Basis of Design (Underground Pipeline Systems)
2. 30-99-12-0033 (AON) Pipeline Basis of Design (Aboveground Pipeline Systems)
3. 30-99-12-0028 (AON) Specification for Under Ground Pipeline Construction
4. 30-99-12-0026 (AON) Specification for Above Ground Pipeline Construction

## I.2 EXCLUSION

This document does not cover offshore pipelines which are covered by AGES-SP-10-002.

## I.3 ABBREVIATIONS

The following abbreviations are used in this document.

| Abbreviations | |
|---|---|
| °C | Degrees Celsius |
| ADNOC | Abu Dhabi National Oil Company |
| ADNOC Onshore | Abu Dhabi Company for Onshore Petroleum Operations Limited |
| AG | Above Ground |
| AGI | Above Ground Installation |
| AON | ADNOC Onshore |
| CICPA | Critical Infrastructure and Costal Protection Authority |
| CP | Cathodic Protection |
| DEP | (Shell) Design Engineering Practice |
| D/t | Pipe Diameter to Wall Thickness ratio |
| EPC | Engineering, Procurement and Construction |
| ES | Engineering Standard |

| Abbreviations | |
|---|---|
| ESD | Emergency Shutdown |
| ETIMAD | ETIMAD Strategic Security Solutions |
| FEED | Front End Engineering Design |
| FOC | Fibre Optic Cable |
| GIS | Geographical Information System |
| HDD | Horizontal Directional Drilling |
| HSE | Health, Safety, Environment |
| MOL | Main Oil Line |
| NDT | Non Destructive Testing |
| QRA | Quantitative Risk Assessment |
| RDS | Remote Degassing Station |
| ROW | Right Of Way |
| SAW | Submerged Arc Welding |
| SMYS | Specified Minimum Yield Strength |
| UAE | United Arab Emirates |
| UG | Under Ground |
| WI | Water Injection |

## I.4 DEFINITIONS

The terms used in this document are defined as below.

| Definitions | |
|---|---|
| Company | ADNOC |
| Contractor | The party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of the project. |
| Field | All upstream, midstream and downstream oil, gas and refineries fields and plants across UAE |
| Manufacturer/ Vendor | The party (parties) which manufactures and/or supplies materials, equipment, technical documents or drawings and/or services to perform the duties specified by the Company. |
| may | Is used where alternatives/actions are equally acceptable. |

| Definitions | |
|---|---|
| must | Indicates a legal or statutory requirement |
| Project | As applicable |
| shall | Indicates mandatory requirement |
| should | Indicates a strong recommendation to comply with the requirements of this document. |
| Supplier/Bidder | All the possible entities contacted before an order is placed. |
| Technical deviation/ Concession request | A deviation requested by the Contractor, Usually after receiving the contract package or purchase order. Often, it refers to an authorization to use, repair, recondition, reclaim, or release materials, components but doesn't comply with project requirements. A concession request is subject to Company approval. |

## I.5 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

The terms used in this document are defined as below.

| Document No. | Document Title |
|---|---|
| **ADNOC Onshore Documents** | |
| 30-99-00-0041-2 | Welding of Pipeline and Related Facilities(Amendment /Supplement) to ISO 13847 |
| 30-99-00-0103 | Pipelines Launcher & Receiver System |
| 30-99-12-0029 | Pipeline Upheaval Buckling Calculations Methodology |
| 30-99-12-0112 | Specification for Piping Stress Analysis |
| 30-99-22-0006 | Pipeline Typical Details (Drawings) |
| 30-99-22-0007 | Pipeline Typical Details (Drawings) |
| 30-99-23-0016 | Specification for Line pipe Induction Bends |
| 30-99-23-0114 | Pre-Commissioning of Pipelines |
| 30-99-23-0115 | Specification for Pipeline Isolating Joints |
| 30-99-23-0116 | Specification for Induction Bends |
| 30-99-23-0122 | Specification for Pipeline Barred Tee |
| 30-99-23-0123 | Specification for Pipeline Flanges |
| 30-99-37-0004 | CIPS & DCVG Survey |
| 30-99-37-0013 | Painting and Coating of New Equipment |
| 30-99-68-0005 | Laying Telecom Cables in the Vicinity of Pipes, Power Cables and Roads |
| 30-99-75-0050 | Topographical Survey of Pipeline Routes, Well Head and Plant Areas |

| Document No. | Document Title |
|---|---|
| 30-99-90-0055 | Pipeline Pre-commissioning and Preservation |
| 30-99-90-0279 | Site Applied Coating and Cathodic Protection for Pipeline Sections at Road/Track/Fence Crossings. |
| 30-99-91-003 | Guidelines for Preparation of a Project Health, Safety and Environmental (HSE) Philosophy Document |
| 31-38-60-10 A | Hot-Tapping on Pipelines, Piping and Equipment |
| 31-40-40-38 A | Hydrostatic Pressure Testing of New Pipelines |
| **ADNOC Standards** | |
| AGES-GL-03-001 | Layouts & Safe Distances Guidelines |
| AGES-GL-07-001 | Material Selection Guidelines |
| AGES-SP-07-001 | Cathodic Protection Specification |
| AGES-SP-07-002 | External Pipeline Coatings Specification |
| AGES-SP-09-003 | Piping & Pipeline Valves Specification |
| AGES-SP-10-001 | Specification for Line Pipe (Amendments/ Supplements to API Specification 5L) |
| AGES-SP-10-002 | Specification for Subsea Pipeline Systems (Amendments/Supplements to DNVGL-ST-F101) |
| **International Codes and Standards** | |
| API Specification 5L | Line Pipe |
| API Specification 5LC | CRA Line Pipe |
| API Specification 5LD | CRA Clad or Lined Steel Pipe |
| API Standard 1104 | Welding Of Pipelines and Related Facilities |
| API RP 1102 | Steel Pipelines Crossing Railroads and Highways |
| API RP 5LW | Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels |
| API RP 1102 | Steel Pipelines Crossing Railroads and Highways |
| API RP 1110 | Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide |
| API RP 5L5 | Recommended Practice for Marine Transportation of Line Pipe |
| API STD 1104 | Welding of Pipelines and related Facilities |
| ASME B16.20 | Metallic Gaskets for Pipe Flange |
| ASME B16.47 | Large Diameter Steel Flanges: NPS 26 through NPS 60 Metric / Inch Standard |
| ASME B16.5 | Pipe Flanges and Flanged Fittings |
| ASME B16.9 | Factory-made Wrought Buttwelding Fittings |

| Document No. | Document Title |
|---|---|
| ASME B31.3 | Process Piping |
| ASME B31.4 | Pipeline Transportation System for Liquid Hydrocarbons and Other Liquids. |
| ASME B31.8 | Gas Transmission & Distribution Piping Systems |
| ASTM A370 | Standard Test Methods and Definitions for Mechanical Testing of Steel Products |
| ASTM E164 | Standard Practice for Contact Ultrasonic Testing of Weldments |
| ASTM E165 | Standard Practices for Liquid Penetrant Examination |
| ASTM E709 | Standard Guides for Magnetic Particle Testing |
| ASTM E747 | Standard Practice for Design, Manufacture and Material Grouping Classification of Wire Image Quality Indicators (IQI) Used for Radiology |
| ASTM E92 | Standard Test Method for Vickers Hardness of Metallic Materials |
| BS EN 10204 | Metallic Products - Types of Inspection Documents |
| BSI: PD 8010-1 | Part-1: Steel Pipelines on Land. |
| ISO 3183-3 | Petroleum and Natural Gas Industries - Steel Pipe for Pipelines |
| ISO 8501-1 | Preparation of steel substrates before application of paints and related products - Visual Assessment of Surface Cleanliness - Part 1: Rust Grades and Preparation Grades of Uncoated Steel Substrates and of Steel Substrates After Overall Removal of Previous Coatings |
| ISO 14313 | Petroleum and Natural Gas Industries – Pipeline Transportation Systems – Pipeline Valves |
| ISO 15156 ( part 1, 2 & 3) | Petroleum and Natural Gas Industries - Materials for Use in $H_2S$ Containing Environment in Oil & Gas Production. |
| ISO 15590-1 | Petroleum and Natural Gas Industries – Induction Bends, Fittings and Flanges for Pipeline Transportation Systems – Part 1: Induction Bends |
| ISO 15590-2 | Petroleum and Natural Gas Industries – Induction Bends, Fittings and Flanges for Pipeline Transportation Systems – Part 2: Fittings |
| ISO 15590-3 | Petroleum and Natural Gas Industries -- Induction Bends, Fittings and Flanges for Pipeline Transportation Systems -- Part 3: Flanges |
| ISO 13623 | Petroleum and Natural Gas Industries Pipeline Transportation Systems |
| ISO 10474 | Steel and Steel Products - Inspection Documents |
| ISO 15589-1 | Petroleum and Natural Gas Industries – Cathodic Protection of Pipeline Transportation Systems - Part 1: On-Land Pipeline |
| MSS SP-44 | Steel Pipeline Flanges |
| MSS SP-75 | Specification for High Test Wrought Welding Fittings |
| NACE MR 0175 / ISO 15156 (Part 1 to 3) | Petroleum and Natural Gas Industries - Materials for Use in $H_2S$-Containing Environments in Oil and Gas Production |
| NACE SP0177 | Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems |
| NACE STD RP0274 | High-Voltage Electrical Inspection of Pipeline Coatings |

| Document No. | Document Title |
|---|---|
| NACE TM0284 | Evaluation of Pipeline and Pressure Vessel Steels for Resistance to Hydrogen-Induced Cracking |
| NACE SP0102 | Standard Practice Inline Inspection of Pipelines |
| SSPC - SP | Steel Structures Painting Council Surface Preparation |
| **Other** | |
| International Journal for Piping, Engineering, Practice 3R International- Edition-2006 | About Upheaval and Lateral Buckling of Embedded Pipelines by Dr. K. Peter |
| ESS-TSD-GEN-PRD-0004 | Smart Fence Crossing Procedure (CICPA) |

## I.6 DESIGN CODES AND STANDARDS HIERARCHY

The work on the project shall be performed to the following regulations, codes and standards, which are in order of precedence:

- The laws, standards and regulations of United Arab Emirates
- ADNOC code of practice
- Project basis of design and any specific requirements that are not covered by this specification
- ADNOC specifications, procedures, engineering practice, ADNOC amendments / supplements / additional requirements to Shell DEPs
- International oil & gas industry codes, standards, and recommended practices (all where specified in above or, where none of the above is applicable, as proposed by contractor and approved by ADNOC)
- Internationally recognized oil and gas industry practices

The information given in each of the above shall be used in conjunction with all other above listed documents.

In cases of conflict among documents of the same levels in the hierarchy, the most stringent requirements shall apply. In such cases, the contractor shall provide its interpretation in writing of the most stringent requirement for approval by ADNOC utilizing a Technical Query (TQ) sheet. In all such cases of conflict ADNOC decision shall be final.

The revision of documents current at the time of contract award shall be generally used, unless stated otherwise.

## I.7 SPECIFICATION DEVIATION / CONCESSION CONTROL

Any technical deviations to this specification shall be obtained by the contractor only through formal concession request. The concession request requires Company's review/ approval prior to implementation of the proposed changes. Technical changes implemented prior to Company approval are subject to rejection.

## I.8 QUALITY ASSURANCE/ QUALITY CONTROL

The Contractor shall have in effect at all times, a QA/QC program, which clearly establishes the authority and responsibility of those responsible for the quality system. Persons performing quality functions shall have sufficient and well defined authority to enforce quality requirements that initiate, identify, recommend and provide solutions to quality problems and verify the effectiveness of the corrective action.

Contractor shall submit QA/QC program to the Company for review & approval prior to commencement of pipeline construction.

The Contractor shall identify in documents to its manufacturers, suppliers, vendors and subcontractors all applicable QA/QC requirements imposed by the Company, and shall ensure compliance. On request, Contractor shall provide objective evidence of its QA/QC surveillance for all levels of its activity.

The Company reserves the right to inspect materials and workmanship at all stages of manufacturing, fabrication & construction and also witness any or all tests. The Contractor shall provide the Company with a copy of its manufacturing and inspection plan for review and inclusion of any mandatory Company witness points.

Material certification and traceability shall be in accordance with section III.29 of this specification.

## I.9 SAFETY

Contractor shall make itself fully aware of the safety requirements of Company for working in the proximity of live facilities and shall strictly comply with the same.

At all times safety regulations within the development area shall be observed. The permit to work system shall be fully understood before commencement of any work.

Required permit to work as applicable shall be in accordance with ADNOC Onshore Manual 10.

Further details regarding safety shall be as per 30-99-91-003 (AON).

# II Pipeline Design

The pipeline shall be designed in accordance with the relevant sections of ASME B31.4/B31.8, as applicable, supplemented by this document.

The pipeline shall be designed taking into consideration the design and operating conditions and requirements over its entire projected life cycle including final abandonment, the characteristics of the fluids to be transported, the pressure and temperature requirements, the mode of operations, the geographic location, and the environmental conditions.

## II.1 DESIGN PHILOSOPHY AND OPERATING REQUIREMENTS

### II.1.1 Bends

The use of hot bends shall be avoided and wherever possible, bends shall be formed by bending the pipe using field/cold bends

a) Elastic Bends

The minimum elastic bending radius shall be in accordance with II.5.5.

b) Field Bends / Cold Bends

The minimum bend radius shall be 40D, where D is the pipe outside diameter. However in case the calculations prove that larger bend radius is needed, it shall be considered to avoid excessive stresses.

Maximum cold bend angle shall no exceed 45°.

Consecutive bends shall be spaced at least with 5 (five) meters tangent between them measured along the pipeline axis, however in all cases the straight pipeline section between two consecutive bends (field bends or induction bends) shall be greater than the longest commercial intelligent pig dimensions or as specified in for pig traps whichever is greater.

c) Induction Bends

Induction bends may be specified wherever the installation of field bends is not practical, i.e., where obstructions cannot be avoided or when limitation of space constraints.

Maximum bend angle shall not exceed 90° and hot bends shall follow standard angles of 22.5°, 45° and 90°. Non-standard angles shall be avoided wherever practically possible.

Induction bends shall conform to the Company engineering standard for hot induction bend 30-99-23-0116 (AON).

The minimum bend radius for pipe nominal diameters of 150-mm (6-in) and above shall be 5D and for pipe nominal diameter less than 150-mm (6-in) shall be 10D (where D is the pipe outside diameter). All induction bends shall be supplied with straight tangent ends at least 1000-mm in length.

Fabricated mitered or segmented bends are not allowed.

### II.1.2 Valves

Mainline valves shall be either full bore ball valves or through conduit gate valves as per relevant data sheets. Valves shall be operated manually by hand wheel lever or pneumatic, hydraulic, otherwise specified in the relevant data sheet, or electric motor actuators, as specified on the relevant valve data sheet. The pipeline valve shall be top entry for easy maintenance unless otherwise specified in the relevant data sheet

All transfer lines, gas export, and the MOL shall have battery limit MOV valves which shall be suitable for intelligent pigging.

Pipeline valves shall comply with the requirements of Company engineering standard AGES-SP-09-003.

Aboveground valves shall generally be flanged and shall comply with ASME B16.5 / MSS-SP-44. Pipeline sectionalising valves (if applicable), shall also be flanged and installed aboveground inside stations or in concrete pits (i.e. block valve stations) for the cross country and cross fields pipelines.

ESD valves, Motor Operated Valve (MOV's), and pipeline sectioning valves located in a hazardous area (as defined on hazardous area classification drawings) shall be certified fire safe in accordance with the applicable standards.

| Valve Type | Function | Cause |
|---|---|---|
| SV | Pipeline sectioning | Local and remote operation |
| ESDV | - Process isolation<br>- Pipeline isolation at plant battery limit | Process variable exceeding trip limit plant ESD |
| Pig trap<br>isolation valve | Pig trap isolation | Local actuation for pigging operation |

### II.1.3 Branch Connection and Fittings

For all pipeline pig trap nozzle fittings, the thicknesses shall be as per the adjoining ASME B31.3 piping, however the material grade of the branch fitting shall be as per the pipeline specified material grade.

Threaded connections (pipe to pipe, fittings), slip-on flanges and mitered connections shall not be used in any part of the pipeline system.

Pup pieces shall not be less than 300 mm in length or one pipe diameter whichever is greater.

All branch pipeline connections shall be provided with a valve to permit isolation of the branch from the pipeline. The specification break between pipeline and piping codes shall be at first flange after the fitting on pipeline.

For mechanical strength purpose, *there shall be no branch, drains or instrument connections smaller than 2" on the pipeline section including pig traps*.

Gaskets for flanged connections shall be as per the project piping material specification's applicable piping class. The number of flanged connections in the pipeline systems shall be minimized and all flanged connections shall be located above ground.

### II.1.4 Pigging of Buried Pipelines

The MOL, transfer lines, water injection headers and all gas pipelines (including gas injection and gas lift headers / sub-headers and flowlines) shall be designed as piggable. The following table defines the requirement for permanent or portable pig traps on individual systems. Pig traps shall be designed in accordance with 30-99-00-0103 (AON).

| Pipeline Description | Piggable Design (Y/N) | Permanent Pig Traps (Y/N) | Pig Trap Isolation Valves (Y/N) | Remarks |
|---|---|---|---|---|
| Main Oil Lines – MOL | Yes | Yes | Yes | |
| Products Pipelines – Cross Fields & Cross Country (NGL and Condensate etc. for AGP) | Yes | Yes | Yes | |
| Transferlines / Trunklines | Yes | Yes | Yes | |
| Gas Export Pipelines – Cross Fields & Cross Country (Sales/lean gas and feed gas etc. for AGP) | Yes | Yes | Yes | |
| Water injection headers | Yes | Yes | Yes | |
| All gas injection/ lift headers | Yes | Yes | Yes | |
| All gas injection/ lift sub-headers | Yes | Yes | Yes | |
| All gas flowlines | Yes | No | Yes | Note-1 & 2 |
| All other flowlines | Yes | No | No | Note-2 |
| Fuel gas line | No | No | Yes | Note-1 |
| $CO_2$ pipelines | Yes | Yes | Yes | |
| Nitrogen Pipeline | Yes | Yes | Yes | |
| Sulphur Pipeline | Yes | No | Yes | Pipeline Installation Above ground |

Notes:

1- Provision of portable pig traps or Pig Valves subject to the integrity recommendations.
2- Pipeline pigging design is subject to each end user and integrity requirements of each ADNOC OPCOs.

Gas production flowlines shall have the provision for connecting portable pigging facilities at both ends of the flowlines. Suitable space inside the station shall be provided to allow the hook up of portable pig traps.

### II.1.5 Testing and Pre-Commissioning

During the FEED phase of the project, the optimum method of pipeline testing and pre-commissioning shall be developed which shall take into account method(s) of test water supply and disposal, dewatering, required level of dryness, method of pipeline drying and introduction of product into the pipeline.

During the detail engineering, philosophy and procedures document required for the successful commissioning of the project facilities shall be developed.

Cleaning, gauging, testing, drying and pre-commissioning activities shall be performed in accordance with 31-40-40-38A (AON).

## II.2 DESIGN CODE LIMITS

The pipeline extends from pig trap to pig trap and includes the pig traps and associated pipe work and valves, or, in case if no pig trap is fitted, then it shall be up to the first isolation valve/flange within the plant or wellhead facility boundary. The demarcation between the pipeline and the facility is specified with break between pipeline design code ASME B31.4/ B31.8 and the station piping design code ASME B31.3.

Design code break between ASME B31.8/ B31.4 and ASME B31.3 shall be used as shown in Figure 1 of 30-99-00-0103 (AON) Pipelines Launcher & Receiver System.

## II.3 DESIGN DATA

### II.3.1 Design Life

Basically the design life for all the pipelines shall be 30 years. Special case pipelines could be less than 30 years based on their application and studies approved by the Company.

### II.3.2 General & Environmental Data

The following climatic conditions are typical & generic at the job site; the project specific environmental data shall be further confirmed based on actual field conditions.

Climatic Conditions

| | | |
|---|---|---|
| Wind: | - Prevailing direction from NW | |
| | - Design wind speed | 45 metre/sec |
| Ambient Temperature: | - Maximum solar | 85°C |
| | - Maximum shade | 58°C |
| | - Average shade | 28°C |
| | - Minimum shade | 4°C |
| Soil Temperature at 1.0 m depth: | - Summer | 38°C |
| | - Winter | 13° C |

| | | |
|---|---|---|
| Humidity: | - Relative maximum at | 43°C – 95% |
| Rainfall: | - Infrequent | |
| | - Maximum | 51 mm/year |
| Dew : | - Heavy | |
| Terrain Soil Type: | - Mostly sand, loose to medium density | |
| Features: | - Desert areas, with traces of Sabkha | |

**Special remarks**

The site has fluctuating temperature and wind, combined with high humidity and persistent dust. Heavy, salty dew is frequent. All equipment shall be designed for high ambient temperatures and high surface temperatures due to solar radiation.

The winter season is characterised by winds, reaching gale force at times, preceded by clouds, rain and thunderstorms.

Strong N.W. winds may persist for several days, often reaching gale force and accompanied by widespread dust/ sand storms for periods of 3-4 days. Severe fog conditions exist with visibility less than 0.5 meters from midnight to 8 a.m. during the seasonal transition months of April to May and October to November.

Rainfall is extremely rare. Measurable rainfall usually occurs on an average of about 10 days per year, these being confined to the period from October to May. Heavy showers and flash flooding during thunderstorms are common.

Sandstorms are frequent and saliferous dust adheres to all exposed surfaces

### II.3.3 Terrain and Geology

ADNOC onshore fields include terrains of sand dunes, rocky and Sabkha regions. Project specific terrain & site geology shall be referred to where the pipelines would be installed.

### II.3.4 Pipeline Categories

The pipeline categorization shall be in accordance with fluid product types as per the table below.

| Category | Product Type | Code | Pipelines |
|---|---|---|---|
| A | Non-flammable, water-based fluids. | ASME B31.4 | Fresh water<br>Aquifer water<br>Water injection headers/ flowlines<br>Produced water (treated) lines<br>Raw water supply |
| B | Flammable and / or fluids that are liquids at ambient atmospheric pressure conditions. Typical examples are oil and petroleum products. Methanol is an example of a flammable and toxic fluid. | ASME B31.4 | Main oil line<br>Product pipelines |

| | | | |
|---|---|---|---|
| C | Non-flammable fluids that are non-toxic gases at ambient temperature and atmospheric pressure conditions. Typical examples are nitrogen, carbon dioxide, argon and air. | ASME B31.8 | Nitrogen gas<br>$CO_2$ pipeline |
| D | Non-toxic, single-phase natural gas. | ASME B31.8 | Natural gas |
| E | Flammable and / or toxic fluids that are gases at ambient temperature and atmospheric pressure conditions and are conveyed as gases and / or liquids. Typical examples are hydrogen, natural gas (otherwise covered in category D), ethane, ethylene, liquefied petroleum gas (such as propane and butane), natural gas liquids, ammonia and chlorines. | ASME B31.8 | Multiphase transfer lines<br><br>All gas lines<br><br>Multiphase production flowlines<br><br>Fuel gas lines |

## II.4 ROUTING

### II.4.1 General

During conceptual study, pipeline routing will be carried out by desktop study. During FEED and EPC phase, the pipeline route shall be further verified by GIS map and topography survey.

Pipeline shall be routed taking into considerations the following:

- Routing of several pipelines / flowlines in the common pipeline corridor.
- Minimize field congestion
- Shortest possible segments to minimize route lengths, following existing field corridors as applicable.
- Optimum number of crossings along the route with existing facilities.
- Minimize shutdown/disturbance to adjacent facilities, roads and access tracks etc.
- Feasibility of construction.
- Maintain minimum safe clearances / distances as per AGES-GL-03-001 and project HSE philosophy.
- Avoid or minimize disturbances to natural environment & ecology.
- Avoid seismically active areas along the route.
- Complying with HSE requirements & environmental regulations.

In case of multiple pipelines to be constructed in one project, the pipeline corridor(s) shall be designed to accommodate current and planned future pipelines. In a pipeline corridor, buried pipelines shall be routed at one side and aboveground flowlines shall be separately routed on the other side of the corridor.

The pipeline corridor layout shall accommodate the sequential installation of buried pipelines and aboveground flowlines to minimize line crossings.

Clearances shall be provided between the buried pipelines and aboveground flowlines and headers for easy access for operation, maintenance and inspection of these pipelines & flowlines and installation of future pipelines & flowlines.

All flowlines and pipelines shall be routed into main defined pipeline corridors before entering / approaching gathering stations and central gathering station.

An access road/track as permanent ROW with a minimum width of 6 meters shall be provided along one side of the full length of all pipelines. In the case of pipeline corridors, common access roads that can adequately cover all the pipelines are sufficient. One access road should cover maximum three or four pipelines in common trench at least from one side, in order to allow maintenance/ repair of pipelines.

Pipeline ROW/ corridor shall not block access to any sector of the field or to any existing facility unless otherwise provision for asphalt road and rig/vehicle crossing is provided.

The effects of overhead power line parallelism shall be considered in detail for all metallic pipelines located within 150m. In such cases the CP design shall be executed by a specialist CP engineering consultant.

### II.4.2 Route Survey

Pipeline topographic route survey shall be carried out as per 30-99-75-0050 (AON).

Detailed survey data should be available prior to carrying out detailed design. These data include:

- Topographical data, location of Sabkha area, location of sand dunes, types of roads, tracks and its density of traffic.
- Foreign facilities and ongoing construction works.
- Soil investigation for soil types, water table, soil properties etc.
- Soil resistivity for cathodic protection design.
- Population and building densities for the establishment of location classes, location of inhabited buildings, taking into account any future land development plans, as advised by government authorities.
- Records of any existing special features, which will need reinstatement after construction is completed.
- Environmental data (climatic, floods, earthquakes, landslides, currents at Wadi crossings, vegetation, fauna).
- Existing facilities within 150m and CP systems, which may influence pipeline design and construction.
- Existing above ground and buried pipelines and cables.
- Existing overhead high voltage power lines.
- Existing pipelines crossing or running along the selected route within the survey area limits.

### II.4.3 Buried Pipelines

Buried pipelines shall be laid either;

- In trenches in sandy and rocky terrains

- On raised embankment made of gatch to elevate the pipeline above the water level in Sabkha terrain.

#### II.4.3.1 Pipeline Separation Distances

The minimum clearances between the new pipelines and existing / planned facilities / services / utilities shall be in accordance with the HSE document AGES-GL-03-001 & applicable project HSE philosophy. Within corridors where pipelines are laid parallel to one another in a trench or alongside / across existing services, the pipelines are required to be laid with the minimum distances as given in the following tables

| Existing Facility / Pipeline | Minimum Separation(Note-1) |
|---|---|
| | Horizontal |
| New buried pipeline installed next to existing 3rd party pipeline or MOL | 15 m |
| New buried pipelines installed in separate trenches | 10 m |
| New buried pipeline installed next to existing buried pipeline other than MOL | 10m |

Notes:

1) The minimum distance for horizontal separation is measured from outside diameter of the pipe.

2) Natural grade level in case of aboveground supported pipe.

Pipelines crossing with existing pipeline corridors shall be at minimum depth of 2.5 m from the natural grade elevation of the corridor.

### II.4.3.2 Multiple Pipelines

Multiple pipelines in shared trenches or elevated embankment, maybe allowed due to limited space or whenever multiple pipelines are laid at same time in accordance with the project specific documents, and in no case this shall affect the maintainability and operability of the pipelines.

In case of multiple pipelines are specified to be shared in the same trench or elevated embankment, then the number of shared pipe line and its separation distances shall be as per the following table:

| Pipeline Types | Maximum Number of Pipelines | Pipelines Size (in) | Minimum Horizontal Distance (mm) (Note-1) |
|---|---|---|---|
| Gas flowlines (production and Injection) – trench | 3 | Up to 8in | 750 |
| Gas lift flowlines – trench | 3 | Up to 8in | 500 |
| Water producers flowlines (GRE) – trench | 3 | Up to 8in | 500 |
| Water producers flowlines (GRE) – elevated construction in Sabkha | 3 | Up to 8in | 500 |
| Gas flowlines (production and injection) – elevated construction in Sabkha | 2 | Up to 8in | 1000 |
| Gas lift flowlines – elevated construction in Sabkha | 2 | Up to 8in | 1000 |
| Oil and gas production and Injection pipelines (headers, transfer lines, trunk lines, export lines and MOLs) – trench | 2 | Up to 36” | 1000 |

| | | | |
|---|---|---|---|
| Oil and gas production and injection pipelines (headers, transfer lines, trunk lines, export lines and MOLs) – elevated construction in Sabkha | 2 | Up to 36” | Note-2 |

Notes:

1. The minimum distance for horizontal separation is based on clear distance between outside diameters of pipes.

2. Pipelines to be laid in different berms inside the same ROW separated with the 6.0m maintenance road (engineering standard drawings 30-99-22-0006 (AON) with the concept of “pipeline–maintenance road–pipeline”.

Allowable separation distances for lateral buckling of single of multiple pipelines shall be calculated on case by case basis for each pipeline taking into consideration pipelines sizes, design and operating conditions, actual soil parameters and nature of Sabkha (dry or wet). Refer to typical drawings 30-99-22-0006 (AON) in Appendix B. Lateral buckling calculation methodology shall be in accordance with 30-99-12-0029 (AON).

### II.4.4 Aboveground Pipeline

All the above ground pipelines / flowlines shall be installed along the route either surface laid or on an elevated concrete sleeper supports/hurdles in Sabkha region.

In Sabkha areas, individual oil/water injection flowlines shall be laid on hurdles, and multiple flowlines / gas flowlines on concrete sleepers. Expansion control in terms of expansion loops/expansion offsets along with required pipe guides, limit stops and anchor points shall be considered in design. At change of direction in Sabkha areas, supports shall be of concrete sleeper.

Concrete sleeper supports shall clear of the ground above natural grade to protect the flowlines from Sabkha environment. Standard concrete sleeper supports to a minimum of 600 mm elevation above natural grade should be used.

Maximum span between concrete sleeper supports for carbon steel flowlines less than 8 inch diameter shall be 6 meters. Minimum spacing between flowlines installed at same time on common concrete sleeper supports shall be 500 mm, otherwise spacing shall be increased to 3000mm for individual flowlines installed on separate sleepers.

Unsupported surface laid flowlines shall be installed as unrestrained pipeline & shall follow natural grade elevation.

In sandy areas, oil /water injection flowlines shall be surface laid at minimum spacing of 1000mm, and gas flowlines/pipelines shall be laid on concrete sleepers. Expansion control for above ground shall be considered in terms of expansion loops or expansion offsets. Sections that have long straight length or restricted by nearby consecutive road crossings shall be provided with expansion loops or expansion offsets. Means of expansion control shall also be analysed and applied to avoid resting of flowlines on top of each other due to excessive lateral expansion/ movement at limited separation distances between surfaces laid pipelines.

Inside the fences, all flowlines shall be elevated and steel supported (concrete support in case of Sabkha) in order to avoid sand accumulation covering the pipe and provide access for inspection.

Aboveground pipelines shall be installed underground at different types of crossings (roads, rig, tracks, asphalt roads, buried/aboveground pipelines and services/utilities in accordance with typical drawings for crossings 30-99-22-0007 (AON) in Appendix B).

In any circumstances, existing flowlines shall not be crossed along flowline route at non approved crossing. Only approved/ designated crossing locations shall be used.

In case of field development in phases, corridor shall accommodate current and future flowlines sequential installation of surface laid flowlines. Future flowlines should not be laid in between live lines unless there is enough room/ space for installation of expansion loops/ offsets and construction activities. Pipe crossings shall be minimized as far as practicable.

#### II.4.4.1 Separation Distance

The minimum safe distance clearance as given in HSE document AGES-GL-03-001 & project HSE Philosophy shall be maintained from existing/ planned facilities for the route selection of new pipeline.

Safe distances from third party (foreign) facilities shall comply with their code of practices and approved officially through No Objection Certificate (NOC) prior to construction.

Where the separation requirement is not met, a deviation request shall be raised for approval by the relevant party. Any deviation request is to include a QRA as part of the justification.

Pipelines crossing with existing pipeline corridors shall be at minimum depth of 2.5 m from the natural grade elevation.

| Pipeline Condition | Minimum Separation(Note-1) | |
|---|---|---|
| | Vertical | Horizontal |
| Aboveground flowlines ( laid on sleeper supports) | 0.5 m | 0.5 m |
| Existing foreign (3rd party) pipeline or MOL | 1.0 m | 15 m |
| Pipeline or existing service and cable crossings (buried) | 1.0 m | - |
| Pipeline or existing service crossing (above ground) | 1.5 m | - |

**Note:**

1) The minimum distance for vertical separation is measured from:
   - Bottom of pipe in case of surface laid or buried pipe
   - Grade in case of supported above ground pipe

The minimum distance for horizontal separation is measured from outside diameter of the pipe.

### II.4.5 Establishment of Location Classes

Based on the survey data, appropriate location classes shall be specified along the pipeline route for pipelines transporting category C, D, M and E, in accordance with ASME B31.8 Article 840.2. There is

no specific requirement for pipelines transporting category A and B fluids, apart from access requirements during construction and for maintenance and emergency services during operations.

ASME B31.8 Article 840.2.2 identifies 4 location classes, ranging from location class 1(less populated areas) to location class 4 (densely populated areas). Since location classes are used for the determination of the design factor, the route selection shall take due regard for impact of the routing considerations per section 7.3.2 on pipeline sections in location classes of higher category (e.g. class 3 and class 4).

As all fields are of desert nature and has no population habitation, location class 1 division 2 with design factor of 0.72 shall be minimum. For crossings, minimum design factor shall be 0.6 satisfying the thickness requirement per API RP 1102. The location class shall be appropriately selected if population habitation is found or planned along the pipeline route.

## II.5 PIPELINE MECHANICAL DESIGN

### II.5.1 General

Pipeline mechanical design shall include the following:

- Wall thickness selection of pipe and bend mother pipe
- Crossing design
- Stress analysis
- Buoyancy control
- Upheaval buckling control for buried pipelines

### II.5.2 Hoop Stress Design Factor

Design factors to be used for calculating pipeline /flowline wall thickness, applicable for location class1, div.2 (desert location) of ASME B31.8, are listed below. Other design factors, applicable as per location class defined by ASME B31.8, shall be selected based on project specific requirement.

| Location | Hoop Stress Design Factors Designation (F) | |
|---|---|---|
| Fluid category | A+B | C+D+E |
| General route | 0.72 | 0.72 |
| Private roads | 0.72 | 0.60 |
| Crossings – unimproved public roads, roads, rigs, highways, streets | 0.60 | 0.60 |
| Parallel encroachments – private roads, unimproved public roads, highways, streets (Note 1) | 0.72 | 0.60 |
| Fabricated Assemblies (Note 2) | 0.60 | 0.60 |

| | | |
|---|---|---|
| Pipeline near population density | 0.72 | 0.50 |
| Pipeline within plant fences, block valve station and pig trap stations, and up to 200m outside a plant | 0.60 | 0.60 |

**Notes**:

1) Parallel encroachments are defined as sections of a pipeline running parallel to existing roads. These sections shall be subject to QRA.
2) Fabricated assemblies include pig traps, valve stations, headers, etc.

When adopting design factor, due consideration shall be given to possible future development in the area.

### II.5.3 Pipeline Wall Thickness

#### II.5.3.1 The minimum wall thickness

The criteria governing selection of minimum nominal pipe wall thickness are as follows:

Minimum nominal pipe wall thickness shall be 4.8mm.
Maximum D/t shall be 96 for pipelines on land.

Wall thickness shall be increased more than the designed thickness in case of integrity requirements based on risk study recommendations for trenchless crossings of public high ways, railways or water channels.

#### II.5.3.2 Calculation Methodology

It shall be calculated as per Para 841.1.1 of ASME B31.8 or Para. 402.3 of ASME B31.4 as per specified applicable standard. The nominal wall thickness is calculated in accordance with the following equations:

$$t = P \times D / 2 \times S \times F \times E \times T$$

And

$$t_n = t + A$$

Where:

$t_n$ = Nominal wall thickness satisfying requirements for pressure and allowances
t = Pressure design wall thickness
$P_i$ = Internal design pressure
D = Outside diameter of pipe
F = Design factor
S = Specified Minimum Yield Strength (SMYS) of pipe material
E = Longitudinal joint factor
A = Sum of allowances for threading, grooving and corrosion.
T = Temperature de-rating factor

While setting design factor, due consideration shall be given to, and allowance made for the under-thickness tolerance and maximum allowable depth of imperfections.

External interference by third parties is not considered to be criteria for minimum pipe wall thickness as the pipeline will be laid in Company designated pipeline corridors.

In addition, pipe wall thickness selected per above shall be verified to satisfy the computational stress analysis requirements, prior to placing the purchase order for line pipe materials.

#### II.5.3.3 Pipeline Bend wall Thinning

The thinning as a percentage of the line pipe wall thickness is given by the empirical formula stated in BSI: PD 8010-1 below:

Percentage wall thinning = 50 / (n+1)

Where;
n = inner bend radius divided by pipe outer diameter OD.

The calculations to specify actual mother pipe wall thickness for bends shall be performed by the bend manufacturer.

## II.5.4 Stress Analysis

### II.5.4.1 General

Stress analysis shall be performed to verify and confirm that the stresses are in compliance with the requirements of the ASME B 31.8/ B31.4 code and this document.

Preliminary stress analysis shall be performed during FEED stage. Detailed stress analysis shall be performed during detailed design.

COADE engineering software CAESAR-II shall be used for performing the pipeline stress analysis.

All factors and loadings influencing the pipeline wall thickness shall be considered. Stress analysis shall take into account route alignment, soil characteristics and different types of road crossings.

Stress analysis calculations shall be performed based on the pipeline design conditions at maximum/minimum temperatures. The pipeline installation temperature is 21°C.

The actual profile variations, based on the topographical survey, shall be used for modelling / the pipeline stress analysis node.

Stress analysis shall take into account the differential expansion between existing and new pipelines in case of tie-in to existing pipelines. Z- shaped configuration with field bends or offsets, at tie-ins, shall be used as appropriate, to avoid lateral loads / expansion imposed at the tie-in boundary condition resulting from the branched off pipelines and main pipeline.

Pipe stress and flexibility analysis shall be performed for the entire length of pipelines from the pig launcher to the receiver including:

- Pipeline station approach areas, including the station piping to confirm the state of stresses for the piping configuration and impact of pipeline loads on piping and vice versa. The pipeline movements shall be suitably controlled to minimize the end displacement at station approach. The maximum allowable axial movement of pig traps shall be as limited to ± 50mm with zero lateral movements and uplift directions.

- All road and track crossings where there is a change of alignment and/or bends near the crossings.

- Pipeline stress analysis model shall not be limited to the virtual anchor location but shall include entire pipeline route. In case of stress model exceeds the maximum number of allowed elements/nodes, the total pipeline route can be divided into multiple stress models to overcome the software limitation; if any.

- Expansion of U/G pipelines shall be suitably controlled (restrained/anchored) to eliminate / minimize the impact on-plot piping system. Pipelines shall be suitably restrained/anchored (e.g. limit stop etc.) near the battery limit inside the fence.

- The stress analysis model shall extend to include the aboveground piping within the B31.3 code associated with the pipeline system till the nearest anchor/ limit stop.

The thermal stresses shall be calculated based on stress free installation temperature of 21°C against the maximum/minimum design temperature for both AG and UG sections.

The flowlines in the corridor normally run with a spacing (centre to centre distance) of 1m. The stress analysis shall check the maximum lateral deflections in the system to make sure that the adjacent flowlines do not cross each other while in operation considering the spacing of 1m.

The design shall be adopted to add flexibility by introducing expansion loops across the route while the lateral deflections of the line shall be within the one meter limits so that the group of lines will not touch any of the adjacent lines.

In case of tie in to oil flowline sharing well, an expansion offset at the tie in point shall be considered for flexibility and differential expansion control while branch portion shall not impact header flexibility or introducing any excessive loads.

Whenever the stress analysis results show that the flexibility of flowline profile is not sufficient to bring the stresses to be within the allowable limits; extra flexibility shall be added into the design. Various options such as providing expansion offset as far as practical, providing half expansion loops at existing tracks and at new tracks, providing full expansion loops etc.

Introduce expansion loops using 40D cold bends with 45 degrees angles may be considered while loops may be assigned for approximate length of 750m or less.

Cold bend shall be modelled based on the maximum cold bend angle per each double random length. Physical conditions of all buried crossings shall be appropriately taken care in the modelling.

System stresses are calculated for the various load combinations and compared with the code allowable stresses and all stresses shall be within the limits. The supports at the aboveground sections shall be selected or designed based on the loading from detailed stress analysis in detailed design phase.

For flow lines which are connected to existing header & new sub headers, as far as possible, all adjacent lines or lines connected to a common sub-header shall be modelled in a single convenient model to have better boundary conditions. When lines cannot be considered in a single model due to limitations of computer resources or limitation of maximum number of nodal points that the software can handle, the same are split and considered in different models.

The actual profile variations, based on the topographical survey, shall be considered in the modelling/ stress analysis in the detail engineering phase by EPC Contractor.

The pipeline design conditions (pressure & temperature) shall be used for the applicable load cases, however pipeline operating conditions should also be included as separate load cases and the most conservative stress analysis outcomes shall be incorporated in the final design.

The load cases (minimum) considered for stress analysis are as below,

L1. OPE: W+T1+P1
L2. OPE: W+T2+P1
L3. SUS: W+P1
L4. EXP: L1- L2

Where,
W - Dead weight
T1 - Design temperature (maximum)
T2 - Design temperature (minimum)
P1 - Design pressure

Hydrotest pressure case shall also be carried out during detailed design. Externally imposed displacements and any other occasional load case (e.g. seismic etc.) have to be included as applicable. System stresses are calculated for the applicable load combinations and compared for compliance against the code allowable stresses.

The stress analysis model for pipeline tied-in with existing pipeline shall extend to include the existing pipeline distribution network up to nearest anchorage.

Buried sections may be modelled by the soil modeller of Caesar II, or as per American Lifeline Alliances method. Alternative, soil parameters may be calculated as per the technical methods described by r+k Consulting Engineers, Rijswijk, NL: "Proposal for a method for the determination of pipe/soil parameters" dated October 2000.

### II.5.4.2 Wall Thickness Code Stress Compliance

As per ASME B31.8 and ASME B31.4 Codes, the following equation shall be satisfied:

$$S_L + S_h + S_b \leq 0.9 \times \text{SMYS of pipe}$$

However, additional safe margin shall be allowed to account for un expected construction stresses which may result from unforeseen changes in pipeline profile and construction changes/deviations, the calculated stresses shall not exceed 95% of the above code allowable stress (i.e. 0.95 x 0.90 x SMYS of pipe).
Where:

$S_L$= Compressive longitudinal stress = $E\,\alpha\,(T_2 - T_1)$ - $\nu\,S_h$
$S_h$= Hoop stress = $PD/2(t_n - A)$
$S_b$= Elastic bending stress = ED/2R. (However, Sb will not be considered in the above formula as per ASME B31.8 and ASME B31.4. $S_b$ will be considered when checking and calculating the minimum elastic bend radius).
E = Young's modulus for steel
α = Steel thermal coefficient of expansion
$T_2$ = Maximum operating (design) temperature
$T_1$ = Pipeline installation temperature
$\nu$ = Poisson's ratio
P = Design pressure
D = Pipe outside diameter
$t_n$= Pipe nominal wall thickness
A = Corrosion allowance

R = Elastic bend radius

The following will be the limits of calculated stresses due to sustained loads and thermal expansion:

- Internal pressure stresses: The calculated stresses due to internal pressure shall not exceed the allowable value of F x S, where S = SMYS of pipe and F = appropriate design factor;
- External pressure stresses: Stresses due to external pressure with appropriate design factor;
- Allowable expansion stresses: The allowable equivalent tensile stress shall not exceed 90% of the SMYS; and
- Additive longitudinal stresses: The sum of the longitudinal stresses shall not exceed 75% of the SMYS for unrestrained pipeline sections (ref. 833.6, ASME B31.8 & Table 403.3.1-1, ASME B 31.4) and 90% of SMYS (ref. 833.3 ASME 31.8 & Table 403.3.1-1, ASME B 31.4) for restrained pipeline section
- Other stresses shall be as specified per respective ASME B 31.4/ 31.8.

Pipeline stresses shall be calculated as follows:

1. The equivalent/combined stress will be calculated using von Mises equation:

$$S_{eq} = \sqrt{(S_h^2 + S_L^2 - S_h S_L + 3S_s^2)}$$ (Von Mises equation)

Where:

$S_{eq}$ = Equivalent stress
$S_h$= Hoop stress (due to pressure)
$S_L$= Longitudinal stress (due to pressure, thermal expansion and bending)
$S_s$= Combined shear stress (due to torque and shear force)

During operation, the equivalent stress in the pipeline shall not exceed 90% of SMYS of line pipe material.

2. Hoop stress:

$$S_h = PD/2t$$

3. Longitudinal stress (fully restrained pipeline):

Longitudinal stress $S_L$ includes stress caused by bending in addition to stress caused by pressure and thermal expansion according to the definition of $S_L$:

$$S_L = S_{LA} \pm S_b$$

Where:

$$S_{LA} = \nu(S_h - P) - E\alpha(T_2 - T_1)$$

$$S_b = \pm Ed/2R$$

4. Longitudinal stress (fully unrestrained pipeline):

$$S_L = S_h/2 + M_b/Z$$

5. Combined shear stress:

$$S_s = \frac{1}{2Z} \pm 2F/A_p$$

Where:

$M_b$= Bending moment applied to the pipeline
T = Torque applied to the pipeline

$F_s$= Shear force applied to the pipeline
$A_p$= Pipe wall cross section area
Z = Section modulus

Other symbols have their usual meaning.

### II.5.5 Minimum Elastic Bend Radius

The pipe allowable elastic bending stress shall be calculated based on the net longitudinal allowable longitudinal stress resulting from the balance stress calculated from von Mises equation.

$$S_{eq} = \left[S_L^{\,2} - S_L\ S_h + S_h^{\,2} + 3S_s\right]^{1/2}$$

Where,

$S_L$ = Longitudinal stress (MPa)
$S_h$ = Hoop stress (MPa)

The maximum equivalent stress is limited to the following factored specified minimum yield strength;

$$S_{eq} \le F_{eq}.SMYS$$

Where,

$F_{eq}$ = Equivalent stress design factor = 0.95 x 0.9

From which the equation for the allowable longitudinal compressive / tensile stresses can be derived as follows:

$$S_L = \frac{S_h \pm \sqrt{S_h^2 - 4\left[S_h^2 - \left(F_{eq}.SMYS\right)^2\right]}}{2}$$

Hence, the allowable bending compressive / tensile are calculated as follows

$$S_b = S_L - S_{LA}$$

Where $S_{LA}$ is the longitudinal stress due to internal pressure and temperature defined below.

$S_{LA}=\nu\,(S_h - P) - E\alpha\,(T_2 - T_1)$

Then the minimum radius of curvature for the pipeline elastic bend shall be calculated as follows.

$$R_{min} = \frac{E\,D}{2\,S_b}$$

Where;

E = Young's Modulus
D = Pipe Outside Diameter
$R_{min}$ = Minimum Elastic Bend Radius

### II.5.6 Road/Rig/Track Crossing Calculations

Stresses in pipeline at road crossings shall be verified in accordance to API RP 1102.

Stresses shall be calculated based on fully corroded pipeline, i.e., pipeline nominal wall thickness less the specified corrosion allowance.

Based on the location and type road, track and rig crossings the design factor for the wall thickness calculation shall be specified as per ASME B31.8 clause 841.1.6.

The minimum pipeline burial depth for general route, road, track and rig crossings shall be as per section II.5.11 of this document.

The wheel load to be considered for road crossing stress check shall be 75 kN per wheel with a contact area of 0.06 $m^2$ for all road and track crossings except for rig crossings where a load of 1100 kN per wheel with a contact area of 0.403 $m^2$ shall be applied.

The nominal wall thickness less the corrosion allowance for the wall thickness obtained for design factor (e.g. 0.6) is used as a starting value to evaluate the wall thickness required for satisfying the allowable effective stress limits. In case of failure then higher wall thickness value to be selected for satisfying the allowable pipeline stresses. The specified corrosion all shall be added and the final wall thickness shall be selected based on the nearest higher value per ASME B.36.10.

Using a combination of factors taken from charts in API 1102 the wheel loads are converted into a longitudinal and circumferential stress. The stress in the circumferential (hoop), longitudinal and radial direction are combined to get an effective stress. This combined effective stress is checked to ensure they are within safe limits. An assessment is also made to ensure that the cyclic stress levels are not high enough to cause fatigue at the welds.

The following equations define the acceptable state of stresses;

1. $S_{Hi}\,(Barlow) \le 0.60SMYS$
2. $S_{eff} \le 0.9SMYS$
3. $S_2 \le 0.75SMYS$

Where;

| | |
|---|---|
| $S_{Hi}$ | = Hoop stress due to internal pressure. |
| $S_{eff}$ | = Total effective stress in pipeline. |
| $S_2$ | = Maximum longitudinal stress. |

Nevertheless, for the construction and procurement purposes, the wall thickness corresponding to rig crossings shall be procured for construction of all road/rig crossing types.

## II.5.7 Additional Considerations

### II.5.7.1 Surface Laid Flowline Portions in Sandy Areas

Since the flowline is surface laid (except at road/track/ other pipelines crossings where it is under ground), a direct method for modelling surface laid lines are not available in CAESAR-II (or any other such software) due to the continuous supporting (equivalent to say infinite number of supports) by natural soil along flowline route. Hence the continuous soil supports are taken care of by discrete soil springs and also by selecting such close springs at a distance not exceeding 5D (5*168.3=841.5mm as an example for 6”). Support spacing shall be taken to nearest round figure (for 6” as an example at every 800mm), using the approximate stiffness in the vertical direction and also using friction value of 0.5 (which is typical for such modelling). This modelling approach was discussed and confirmed with COADE (developer of CAESAR-II).

The CAESAR-II procedure for finding the soil support stiffness is as given below:

Make a small stress model of pipeline using the actual design data. The small model could be with 25 nodes, with each node spaced at the 5D distance of the line. The model is to be buried, using the buried modeller of CAESAR-II, with assumed soil depth of half the diameter of the pipeline, and also using the typical soil design parameters. On taking a buried conversion, the program inserts soil springs in the converted model of the sample model. Read the Y2 stiffness as seen in the converted sample model corresponding to a mid-node number (to make it free from the end conditions). This is the stiffness to be used in the actual pipeline model as a normal rest support.

#### II.5.7.2 Elevated Flow line in Sabkha Area

Flowlines in Sabkha areas shall be elevated and resting on steel hurdles or concrete supports and shall be provided with expansion loops/ expansion offsets in order to cater for thermal control and maintain the stresses within the code allowable stresses.

Concrete supports shall be considered at the expansion loops locations, at the change of direction and also at the anchor points. All required anchors, limit stops and guides shall be properly designed in order to avoid flowlines fall down from its supports to the corrosive environmental in Sabkha areas or lifting at any resting support.

Concrete supports shall be used in case of more than one flowlines that to be installed in same corridor at same time. Concrete support width at change of direction shall cater for lateral expansion and over turning moments.

#### II.5.7.3 Flowlines at Different Types of Crossing

Flowlines at crossings shall be provided with means of expansion offsets to provide the required flexibility for the portions on both sides of road. Offset may be on a shape of half side of expansion loop (or 'L' shape) at each side of the crossing.

Buried portion at crossings shall be modelled considering following assumptions.

| | |
|---|---|
| Soil friction coefficient | 0.4 |
| Soil density | 0.0017 Kg/cm$^3$ |
| Depth of soil on top of pipe | 1500mm at track and 2000mm at asphalt road crossings |
| Soil internal friction angle | 30 degrees |

### II.5.8 Pipeline Transition at Above Ground – Below Ground

The pipeline system displacement due to thermal expansion is expected at the pig traps. This movement result with load stresses in the pipeline and the connected above-ground piping. The pipeline movement at the above ground – below ground transition, must be controlled; either by means of adequate flexibility in the pipeline / piping configuration or by suitably sized anchor blocks or both. The most appropriate control measure to minimize and control the movement of the aboveground section under different operation cycles modes of the pipelines life time shall be applicable. The maximum acceptable movements of the first support at aboveground section are:

| | |
|---|---|
| Axial | 20mm |
| Lateral | 10mm |
| Uplift | 0mm |

The anchor force may be estimated using the following equation:

$F_A = A \times (0.5S_h - S_L)$

or,

$F_A$ = A x [(0.5 - ν) $S_h$ + Eα ($T_2$ – $T_1$)]

Where:

$F_A$ = Calculated anchor force

When the aboveground section of the pipeline tends to move due to thermal expansion, the movement is restricted by the axial soil friction force in the buried section of the pipeline. A simplified equation for determining the axial friction force may be given by:

f = μ (2γDH + $W_p$)

Where:

f = Axial friction force per unit length of pipe
μ = Coefficient of friction between soil and pipe coating
γ = Density of backfill soil
H = Depth of soil cover to top of pipe
$W_p$ = Weight of pipe + contents
For pipeline buried in sand, μ = 0.40 is assumed.

The active length of pipeline, maybe calculated using the following formula:

$F_A$ = $f_s$ x L

or,

L = (F) / $f_s$

Where:

L = Active length
$F_A$ = Anchor force / expansion force
Q = End resistance force
$f_s$ = Soil friction force mobilised

The pipeline effective length can be analysed by using stress analysis software CAESAR-II, to determine the end movement and resulting stresses in the pipe. The load cases will include design, hydrotesting, operating, empty condition, slug, thermal expansion, seismic loads and wind loads (where applicable).

The control of the pipeline end movement can be achieved by means of any or a combination of the following:

1. Increasing the depth of cover for specific section of the pipeline calculated effective length to restrain the pipeline movement.
2. Introducing expansion leg on A/G section to provide line flexibility for absorbing the excessive thermal expansion.
3. Improve the soil properties within the pipeline effective length to increase the restraints on the pipeline resulting with reduced thermal expansion.
4. Providing reinforced concrete anchor block.

### II.5.9 Upheaval Buckling Analysis

Detailed upheaval buckling analysis shall be performed for each pipeline to confirm the specified depth of cover for each pipeline.

The pipeline depth of cover shall be measured from the top of pipe to the natural grade level. Upheaval buckling analysis shall be performed in accordance with technical paper published in “Journal for piping engineering practice” (3R International by Dr. K. Peters) and 30-99-12-0029 (AON).

If this assessment indicates that the specified depth of cover is not sufficient to prevent the pipeline from heaving upward through the soil, the design shall be modified to stabilize the pipeline against

upheaval and ensure pipeline stability. The modifications may include provisions for a greater depth of cover or for more flexibility, or other measures approved by ADNOC. The detailed stress analysis shall be performed based upon the modified design. The detailed stress analysis shall confirm that the upheaval will be prevented and that the resulting combination of stresses is in compliance with the code.

Upheaval buckling verification shall be into two phases. The first phase shall be based on the pipeline profile as per alignment sheets where all required upheaval buckling verification/ recommendations shall be highlighted across the route in terms of extra depth of cover or deepening the trench at specific locations as far as practical.

The second phase shall be carried out after pipelines installation. During installation, after lowering of the pipeline and before backfilling, Contractor shall measure the top of pipe elevation every 25m (8in & below), 50m (10inch to 16inch) and100 meters (18inch and above) in the flat areas, and at 10 meters intervals at change of directions for a reasonable distances both sides. The data shall be provided to the Contractor stress engineer to check/ confirm the upheaval buckling study results in phase-II to identify the required damping loads and their locations along all pipelines routes and also to identify the final requirement of backfilling height to stabilize the pipeline.

In case of Phase-2 calculations i.e. final verification check with measured top of pipe elevation taken just before backfilling, the upheaval buckling calculation report shall provide corrective solutions (like the required additional soil cover etc.) in case any problem is observed with the achieved profile.

In Sabkha areas, the requirement for reinforcement of Sabkha construction bund/ berm to avoid lateral buckling shall be checked in accordance with Coulomb soil resistance model (see K. Terzaghi: Theoretical Soil Mechanics, John Wiley and Sons Inc., 1966).

It should be noted that upheaval and lateral buckling were experienced in the past for some pipelines in ADNOC field, where further studies and modified soil models and resistances in different directions (axial, upward, downward and lateral) were performed and have been used in the stress analysis and upheaval buckling checks to rectify the encountered problems.

Upheaval buckling calculations report shall provide calculations for the allowable bending stress, allowable change of angle for vertical and lateral directions for normal and Sabkha sections respectively and other parameters with all details.

The comprehensive analyses along with the recommendations shall be covered in the upheaval buckling analysis report as part of detail engineering.

### II.5.10 On-bottom Stability of Pipelines

Pipelines laid in Sabkha areas shall be installed on a raised embankment made of gatch to elevate them above the water level and pipeline laid in Wadis shall be installed in buried trench. In case of pipeline is direct laid in high water table Sabkha area or rocky area for a distance more than 30m and pipelines in Wadi areas, buoyancy calculation shall be carried out to indicate whether concrete weight coating will be required or not. Concrete weight coating shall be applied to a pipeline for stability purpose. The required concrete coating with minimum 2in thickness shall be established based on the assumptions: Pipeline in the air filled condition. Specific gravity of underlying wet soil with a factor of safety against flotation of 1.25.

The on-bottom stability calculations for pipelines in wet areas are to be performed in accordance with the following equation:

$$\frac{W_{air}}{W_{bouyancy}} > 1.25$$

Where, $W_{buoyancy}$ = Buoyancy of air filled pipeline relative to liquefied ground
$W_{air}$ = Weight of pipeline in air

The pipelines shall be designed to be stable over the design life. This shall be achieved by increasing the weight of concrete coating to give the desired factor of safety. Temporary stabilization during construction shall be considered. Soil weight when buried should be considered for operational cases.

### II.5.11 Pipeline Burial Depth

#### II.5.11.1 Buried Pipelines

For the underground and buried pipeline sections the minimum burial depth shall be as listed in the following table. The design calculations shall be performed using the specified depth of cover subject to stability, upheaval buckling and road/ rig crossing calculations.

| Location | Minimum Cover |
|---|---|
| General route /normal areas | 1.0 m |
| Asphalt and rig road crossing | 2.0 m |
| Sandy track crossings, Govt. roads and gatch track crossings | 1.5 m |
| Sabkha crossings | 1.0 m |

#### II.5.11.2 Sabkha Construction

In Sabkha areas, direct burial in trench shall be avoided due to risk of external corrosion, restricted maintenance access etc. In such areas, the pipeline shall be positioned on the top of ROW on a compacted layer of fill material (gatch). The finished level of compacted fill material shall be a minimum of 0.75 meter above the natural ground (water) level or the water table whichever is higher. See Sabkha pipeline construction in typical pipeline drawings for details.

Following installation, the pipeline shall be padded and backfilled with gatch or approved material forming a berm over the pipe.

Sabkha areas identification shall be as per geotechnical and topographical survey report. Sabkha areas will be avoided wherever practical.

## II.6 PIPELINE CROSSINGS

### II.6.1 Buried Pipeline

New pipeline maintenance road shall be diverted to the nearest official roads on the existing pipelines and buried facilities.

### II.6.1.1 Road / Rig Road / Railway Crossings

Crossing with road/rig roads shall comply with the requirements of API 1102 and the requirements of the road authorities.

The crossing angle may be less than 90° but shall not be less than 60°.

Tracks and minor graded road crossings shall be performed by means of open cut technique, provided that the necessary road closure permits can be obtained from the relevant authorities and relevant third parties.

Rig road crossing shall be constructed by means of open cut technique. Crossings using the open cut technique shall be carried out in accordance with the approved typical drawing.

All asphalt and major road crossings shall be implemented by thrust boring / HDD / micro-tunnelling. Detailed crossing drawing shall be prepared by EPC Contractor for Company review and approval.

Very important notice: Risk study shall be conducted during EPC phase for the railway trenchless crossing to define the crossing methodology by HDD, thrust boring or micro-tunnelling. State if pipeline protection such as casing pipes is recommended with high integrated end sealing to avoid high vibrations being transmitted to the pipeline.

Concrete safety barriers shall be installed at all asphalt road crossings to protect the installed pipeline from third party damage. Safety barriers shall be installed in accordance with the typical drawings and shall extend a minimum of 5 meters either side of the pipeline at crossing location.

All crossings shall meet the Company requirements and specifications and referenced typical Drawings for different type of Crossings.

### II.6.1.2 Foreign services crossings

a) New buried pipeline crossing existing buried cables:
Minimum separation distance to be kept between top of pipe and bottom of existing cable is 1000mm.

b) Overhead power line crossing:
Minimum horizontal distance to be kept between the centreline of pipe and the tower end is 15000mm or 1.5 times the height of the tower as per the requirements of ADNOC HSE philosophy.

c) New buried pipeline crossing existing buried pipeline:
Minimum separation distance to be kept between top of pipe of new pipeline and bottom of pipe of existing pipeline is 1000mm.

d) While crossing existing services / utilities, crossing angle shall be as close to 90° as possible, however, the following minimum crossing angles shall be maintained:

| Service /Utilities | Minimum Crossing Angle |
|---|---|
| Existing pipelines & cables | 60° |
| ETISALAT cables | 90° |
| Overhead power lines | 70° |

| | |
|---|---|
| Unimproved roads, tracks | 60° |
| Metalled roads | 80° |

All asphalt and major road crossings shall be implemented by thrust boring or HDD of carrier pipe without any casing pipes and the crossing angle shall be 90°.

Pipeline shall cross underneath all existing pipelines, cables, etc. with a minimum clearance of 1000 mm.

#### II.6.1.3 Corridors Crossing

Pipeline shall cross below all types of existing Company corridors (for pipelines, cables etc.) with a minimum clearance of 1000 mm.

In general, all crossing with existing corridors shall be carried out by manual excavation. However, for critical corridors in Sabkha or wide corridors, the methodology shall be decided/reviewed as part of constructability review.

Foreign corridors shall be crossed in accordance with third parties requirements through the applicable ROW procedure system.

The new pipeline maintenance road shall be diverted to the nearest official road crossing of the existing corridors.

### II.6.2 Aboveground Pipeline

All crossings shall meet the ADNOC requirements and specifications and typical drawings for different type of crossings.

#### II.6.2.1 Road / Rig Road Crossing

Road/ rig road crossings shall comply with the requirements of API 1102 and the requirements of the road authorities.

The crossing angle shall be as close to 90° as possible but shall not be less than 60°.

The trench under road / track crossing shall be backfilled with excavated sand on top of the pipe padding material. The bottom of the trench shall be provided with compacted fine sand throughout its length, whether in normal ground or rock, so as to provide a minimum compacted bedding thickness of 150 mm below the invert of the pipe and padding of 200mm above & around the pipe.

Track and minor graded road crossings may be performed using an open cut technique, providing the necessary road closure permits can be obtained from the relevant authorities and interested Third Parties.

Steel access barriers shall be installed at all track and rig crossings to protect the installed pipeline from third party damage. Access barriers shall be installed in accordance with the typical drawings.

Rig road crossing shall be constructed using an open cut technique. Crossings using the open cut technique shall be carried out in accordance with the approved typical drawing.

All asphalt and major road crossings shall be implemented by thrust boring / HDD of carrier pipe without any casing pipes. Detailed crossing drawing shall be prepared by EPC contractor.

Concrete Safety barriers shall be installed at all asphalt road crossings to protect the installed pipeline from third party damage. Safety barriers shall be installed in accordance with the Typical Drawings and shall extend a minimum of 5 meters either side of the pipeline at crossing location.

At road crossings, aboveground expansion offsets after the transition spool from buried to aboveground shall be designed to control buried pipeline expansion.

The buried flowline sections & its field weld joints under road crossing shall be externally corrosion coated in accordance with ADNOC specification 30-99-90-0279 (AON).

All crossings shall meet the ADNOC requirements and specifications and referenced Typical Drawings for different type of Crossings.

The recommended minimum cover for flowlines shall be as listed in the table below. Other details shall be as shown in typical pipeline/ detailed crossing drawings (as applicable).

| Location | Minimum Cover (m) |
|---|---|
| Asphalt Road Crossing | 2.0 |
| Gatch Track Crossing | 1.5 |
| Sandy Desert Track Crossing | 1.5 |
| Rig Crossing | 2.0 |

### II.6.2.2 Other Crossings

All aboveground pipelines shall also be installed underground at the following locations:

- ROW of existing pipelines.
- Locations where the pipeline crosses new pipelines or pipelines to be installed as part of the same project.
- Locations where the pipeline crosses planned roads / pipelines and utilities corridor.
- Existing or planned overhead lines crossings along with its right of way.
- Existing surface laid flowlines and their access tracks.
- CICPA fences shall be crossed using thrust boring at 2m depth.
- For existing buried pipelines, cables & utilities, the minimum clearance shall be 1000mm between top of new pipelines and bottom of existing pipeline, cable & utilities.

#### II.6.2.3 Crossing Angle

While new pipeline crossing existing road / services / pipelines /overhead power lines / cables / utilities, shall have crossing angles to be as close to 90 degrees as possible, however, the minimum crossing angle shall not be less than 70 degrees with exception of asphalt road crossings which shall be maintained at 90 degrees.

## II.7 PIPELINE COMPONENTS

### II.7.1 General

All pipeline components specified for sour service shall comply with the requirements of AGES-GL-07-001/ISO15156/NACE MR-0175. Maximum hardness for items in sour service shall not exceed 248 HV10.

### II.7.2 Line Pipe

Carbon steel line pipe material shall conform to API Spec 5L, with the additional requirements specified in ADNOC specification for line pipe AGES-SP-10-001.

### II.7.3 Barred Tees

Barred Tees for piggable pipelines shall be used as per 30-99-23-0122 (AON) and shall be installed for all branches larger than 40% of the main pipeline diameter.

### II.7.4 Flanges

Flanges shall be in accordance with 30-99-23-0123 (AON). Flange type/ facing shall be weld neck/ raised face up to ASME 2500# pressure class. The bore of the welding neck flanges shall correspond to the inside diameter of the connecting line pipe or fitting.

Flanges material grade shall be of the same mechanical / chemical properties of connecting pipeline material grade.

### II.7.5 Pig Signaller

Intrusive and non-intrusive magnetic /ultrasonic type pig signallers may be used for main piggable pipelines in accordance with 30-99-00-0103 (AON).

Pipeline integrity team shall be consulted to agree on the types pig signallers based on the types of running pigs and nature of the service of the pipelines. The selected type shall be subject to the pipeline operation team review and agreement.

### II.7.6 Isolating Joints

Monolithic isolation joints shall be used for electrical isolation between the buried and the aboveground sections of the pipeline. Isolating joint shall be installed in the above ground portion nearest to the pipeline above ground to underground transition, in order to limit the possibility of electrical bridging across the joint. Isolating joint shall be properly supported at both ends and shall not be subject to torsion or bending stress.

Live loads imposed on both ends must be verified against the vendor allowable loads by means of computational stress analysis calculation.

Design of isolation joints shall be as per 30-99-23-0115 (AON).

## II.8 CORROSION PROTECTION

### II.8.1 External Corrosion Coating Requirements

The pipeline external coating shall be selected based on the pipeline process design temperatures. All coating systems shall be in accordance with AGES-SP-07-002 and 30-99-00-0102 (AON).

### II.8.2 Field Joint Coating

Field joint coating systems for the buried pipelines shall be using heat shrink sleeves compatible with the pipeline coating.

### II.8.3 Cathodic Protection

Buried pipelines shall be protected by means of impressed current cathodic protection system. The cathodic protection system shall be designed to provide protection against corrosion for the pipeline design life.

The design of the cathodic protection system shall be in accordance with 30-99-37-0001 (AON). Buried sections of above ground pipeline systems shall have sacrificial anode CP system.

### II.8.4 Internal Corrosion

Pipeline internal corrosion and requirement of line pipe material, reference shall be made to AGES-GL-07-001.

## II.9 PIPELINE WELDING & NDT TESTING

Pipeline welding & non-destructive inspection shall be carried out as per 30-99-00-0041 (AON). All butt welds shall be 100 % radiographed/ automatic UT for automatic welding, as applicable for all pipelines.

## II.10 PRESSURE TESTING

All new pipelines shall be pressure tested following installation and prior to being placed into service. Pressure testing shall be carried out as per 31-40-40-38A (AON).

## II.11 PRE-COMMISSIONING

Pre-commissioning activities shall conform to 30-99-23-0114 (AON). However following activities shall be included:-

- Pipeline de-watering.
- Pipeline drying
- Gauging the pipeline using a calliper tool.
- Pipeline purging and packing.

- Pipeline mothballing (where applicable).
- Preparation of pre-commissioning procedures.
- Provision of warning signs.
- Provision of all equipment, materials weighing, monitoring, recording- and signalling instruments and temporary pipe work facilities and components as required for pre-commissioning.
- Provision of nitrogen, corrosion inhibitors and other consumables.
- Pre-commissioning of all pipelines.
- Removal of all temporary provisions, facilities and components and re-instatement of the permanent system.
- Disposal of dust, chemicals, contaminated water, etc. in accordance with Company approved procedures.

## II.12 PRESERVATION OF PIPELINES

Pipelines shall be preserved in accordance with 30-99-90-0055 (AON).

Preservation of pipelines is required in case of delay in pipelines commissioning. Preservation shall be done by filling with dry nitrogen at 1.5-barg, in accordance with 30-99-23-0114 (AON) and project specific requirements.

Prior to commissioning, pipelines may require to be conditioned with a batch of corrosion inhibitor as described in 30-99-23-0114 (AON).

## II.13 PIPELINE MARKERS

Markers shall be installed along the pipeline route every 1km. All major road/ track and pipeline corridor crossings shall also have markers with pipeline IP to identify the routing of pipeline. The markers shall provide pipeline information in both Arabic and English as per Company standard drawing 30-99-22-0006 (AON).

Pipeline marker shall also have well number painted (in white colour).

Aerial markers will be installed along the pipeline corridor and elsewhere as required by ADNOC standards

## II.14 PIPELINE BASELINE SURVEY

Baseline survey using intelligent pigging shall be performed for piggable gas flowlines, main oil lines, transfer/trunk lines and export pipelines within eight (8) weeks of commissioning commencement of each pipeline. Intelligent pigging baseline survey is not applicable for oil flowlines unless otherwise specified in project scope of work and project specifications. Reference standard for intelligent pigging shall be NACE SP0102.

# III Construction Specification

## III.1 GENERAL

### III.1.1 Introduction

This specification establishes the minimum requirements for the construction of onshore metallic pipelines. Non-metallic and plastic liner pipelines are not covered in this specification.

Contractor shall, with due care and diligence, execute the work in compliance with International working practices and complying fully with all local laws, by-laws, ordinances, regulations, etc.; provide all plant, services and labour, inclusive of supervision thereof; provide all materials, excluding the materials indicated as materials furnished by Company in the CONTRACT; and provide all equipment, appliances or other articles of whatsoever nature required for the execution of the work, whether of a temporary or permanent nature.

All works shall be carried out in compliance with the regulations and requirements of Abu Dhabi and UAE.

Contractor shall take full responsibility for the stability and safety of all operations carried out and all methods of work adopted. The Contractor shall also take full responsibility for stability and safety of all existing facilities/ utilities/ roads/ etc. affected by any construction operation, design and method adopted during executing the work as defined in this specification.

Contractor shall be deemed to have inspected the work area(s) and their surroundings and to have satisfied himself as to the form and nature thereof, including sub-surface conditions, hydrological and climatic conditions, the extent and nature of the work, the materials necessary for the completion of the work and the means of access to all the work area(s). No claims to Company either by way of cost or time shall be admissible on account of non-familiarity with site conditions due to Contractor's failure to fully assess and fully allow for possible conditions throughout the contract period at the work sites or in gaining access to them.

Contractor shall be deemed to have obtained all necessary information as above referenced and have included for all risks, contingencies and any other circumstances, which may influence the work.

Contractor shall, in connection with the work, provide and maintain at his own cost all lights, safety barriers, fencing, watchmen (and associated facilities), etc., when and where necessary, as required by Company or by any duly constituted authority and/ or by the authorities having jurisdiction thereof for the protection of the Work and properties or for the safety and the convenience of the public and/ or others. Notwithstanding the soil type or method of construction indicated in the alignment sheets. Contractor shall use the type of construction required by the actual soil conditions at site after obtaining Company approval as part of his scope of work.

### III.1.2 Scope

This specification defines ADNOC minimum requirements for installation, inspection and testing of both buried and aboveground metallic pipelines. This document standardizes the minimum requirements, and any additional requirements shall be supplemented as per project specific requirement.

Contractor shall prepare detailed method statements and submit to Company for review and approval prior to the planned commencement of any activity.

## III.2 ENGINEERING & CONSTRUCTION CONSIDERATION

### III.2.1 Buried Pipelines

Pipelines shall be installed as underground restrained lines, buried direct in the sandy areas with proper bedding, padding material, and berm with identification marker posts.

In Sabkha areas, as identified by geotechnical reports and project document, pipelines shall be constructed in Sabkha design elevated construction as per this specification.

In case of pipeline crossing by open cut such as rig road, corridors and any other crossing in Sabkha areas, Contractor shall check the pipeline buoyancy and provide proper measures to the pipeline stability.

Contractor shall carry out topographical survey, as part of pipelines engineering works, to select the route of the pipelines, the selection of the route during topographical survey shall consider the pipeline design requirement for the minimum radius of curvature and to introduce TOP survey and its compliance with the elastic bend requirement as a prerequisite to trench backfilling.

In case that project scope of work specify a certain number of pipelines to be constructed in the same trench, Contractor is responsible for the following:

- Contractor shall carry out lateral buckling analysis of each pipeline to assure the safe separation distances between pipelines in normal terrains and Sabkha construction.
- Contractor shall provide adequate design measures for the roads, tracks and facilities' crossings and installation of common culverts wherever specified in the project drawings.
- Transportation, storage, protection and stringing method statements and procedures for the line pipe material of the pipelines in the same trench shall be prepared and submitted for Company review and approval.
- Sequential construction activities of pipelines and overlap between activities such as welding, NDT, field coating and hydrotesting shall be prepared by Contractor and presented during constructability review for Company approval for each shared pipelines bundle in the same trench.
- Contractor shall specify in the construction method statements and during constructability review the following:
  - Permanent ROW for these pipelines bundle.
  - Types of pipeline laying machines and their spans.
  - Welding and NDT crews' arrangement in each construction site.
  - The minimum pipeline section length for hydrotest and the sequences of hydrotest for each pipeline section.
- Contractor shall carry out construction risk assessment sessions for the pipelines NDT & hydrotesting overlapping activities.
- Contractor shall prepare for Company review and approval a procedure for material handling & protection for each line pipe material type (metallic & non-metallic) and Contractor shall ensure of safe handling of each type of material.

### III.2.2 Aboveground Pipelines

Pipelines shall be installed as above ground unrestrained lines, resting on grade surface/sleepers/supports, except at the following locations:

1. Crossings of existing above ground services/ pipelines or underground services/pipelines; the pipeline shall be laid buried underground of these services.

2. Asphalt road crossings/ track crossings/ rig track crossings/ overhead lines right of way crossings, the pipeline shall be laid buried below such roads/ tracks and ROW.

In sandy areas the flowlines shall be surface laid. Expansion control for surface laid pipelines shall be considered in terms of expansion loops or expansion offsets. Sections that have long straight length or restricted by nearby consecutive road crossings shall be provided with expansion loops or expansion offsets. Means of expansion control shall also be applied to avoid resting of flowlines on top of each other due to excessive lateral expansion/ movement at limited separation distances between surface-laid pipelines

In Sabkha areas individual flowlines shall be laid on hurdles and multiple flowlines on concrete sleepers.

Furthermore, in Sabkha areas elevated flowlines shall have concrete sleepers at change of direction to accommodate the lateral displacement and also at anchor points. Expansion control in terms of expansion loops/expansion offsets along with required pipe guides, limit stops and anchor points shall be considered in design.

In case of flowline crossing by open cut such as rig road, corridors and any other crossing, Contractor shall check the pipeline buoyancy in Sabkha and provide proper measures to the pipeline stability.

Contractor shall carry out topographical survey, as part of flowline engineering works, to select the route of the flowlines; the selection of the route during topographical survey shall consider the flowline design requirement for the minimum radius of curvature and to introduce TOP survey and its compliance with the elastic bend requirement.

## III.3 PRE-CONSTRUCTION SURVEY

It shall be the responsibility of the Contractor to verify all survey data furnished to him by Company and to satisfy himself regarding the completeness and accuracy of such data.

Prior to commencement of any construction activities, the Contractor shall carry out a pre-construction survey to identify the pipeline centreline and define ROW boundaries.

A field survey of pipeline routes shall be carried out, and marker posts locating the survey control stations shall be placed. All relevant information shall be collected during the field survey. Contractor shall prepare and submit the collected information in the form of pipeline route maps, alignment sheets, crossing details, etc.

At the location of crossing the corridors as per respective field layouts, boundary limit of corridors shall be marked by the Contractor in all pipeline drawings (route plans, alignments sheets etc.). The boundary of the corridor shall be confirmed by respective asset engineering/master plan teams.

Pre- Construction Survey will be required to establish and confirm the following as a minimum:

- Temporary bench marks.
- Intersection points and deflection angles.
- Pipeline centre line location and chainage.
- Right of Way (ROW) boundaries.
- Pipelines, services, road and track crossings.

- Locations of buried and above ground obstacles and cables.
- Location of cathodic protection test stations where required.
- Boundaries of Sabkha areas if exists.
- Locations where flow lines / headers / sub headers are to be installed below tracks.
- Temporary access to ROW and pipe yards/ dumps.
- Locations of FOC joint pits.
- Boundary limits of corridor.

Contractor shall initially verify all field survey controls. Where the original control points have been destroyed or disturbed, the Contractor shall reinstate these control points to a minimum standard equivalent to "Order C, Class 3 category survey" in accordance with the "Geometric Geodetic Accuracy Standards and Specifications for using GPS Relative Positioning Techniques".

Contractor shall stake the pipeline centreline and ROW corridor in accordance with the "Approved for Construction" alignment sheets. The stakes shall be placed at maximum intervals of 100 m and at all angle points, fences, existing pipelines, existing above or below ground facilities, cathodic protection test points, extra depth ditch locations and at pipeline centreline. Stakes shall also be placed at tangent points, top of sand dunes, etc., to ensure unobstructed centreline visibility in either direction along the pipeline route.

In areas where it is difficult to follow the centreline when staked at 100m intervals, the stakes shall be set at 50 m intervals or less to ensure unobstructed visibility.

Contractor shall establish reference points every 500 meters along the pipeline route. The reference points shall be positioned 25 meters offset from pipeline centreline.

Standard construction limits shall be staked at 200m intervals along the pipeline route. Construction limits for special sections, including but not limited to, extra working width at crossings, extra depth ditch crossings and lay down areas shall also be staked. In case of a single above ground flowline project, or as applicable, this staking/alignment sheet requirement can be waived pending ADNOC approval.

Contractor, as part of his scope of work, shall investigate and establish any development which may have taken place since the topographical survey carried out during engineering phase and shall submit detailed documentation to support any proposed realignment of the surveyed pipeline route resulting from the actual conditions encountered during his investigations or as required by the relevant local authorities. Such development may include but not limited to:

- New well heads and its burn pits, flare, overhead pylons within 150 m.
- High water table area (due to seasonal variation etc).
- High sand dunes.
- Ongoing/ planned projects in the proposed pipeline corridor.
- Exclusion zones (of RDS, RMS etc) overlapping with proposed pipeline corridor.

Any realignment of the surveyed pipeline route shall be subject to Company approval prior to implementation. The final pipeline alignment shall be subject to Company approval.

The upheaval/ lateral buckling and stress analysis shall be checked after the pre-construction survey for construction feasibility.

### III.4 RIGHT-OF-WAY (ROW)

The ROW shall have the dimensions indicated in the scope of survey/alignment sheets approved by Company. The pipeline location in the ROW shall be approved by Company.

Contractor shall coordinate with all local authorities and utility owners to obtain approval on ROW.

Prior to any operation, the Contractor shall become familiar with all provisions on the land allocated for the pipeline alignment and shall comply fully with such provisions and to avoid damage to property, and other pipeline facilities on or adjacent to the ROW.

Contractor shall locate and identify all existing buried and above ground services, such as cables, pipelines, flowlines, water mains, and sewers, including those not shown on the drawings that cross or are at close proximity to the pipeline.

Contractor shall establish contact with relevant authorities, prior to carrying out appropriate surveys and exposing of services by hand excavation.

The located buried services within the ROW shall be fenced by methods approved by Company and clearly marked, identified on the appropriate alignment sheets and fenced by methods approved by Company.

Contractor shall submit for Company approval, proposals detailing the precautionary measures to be taken for avoiding damage to existing pipelines, electrical lines and cables, fences, roads, drainage, and any other existing above or below ground structures or property adjacent to or crossing the pipeline being constructed.

Contractor shall note that the cutting or removal of trees and plantation is strictly prohibited.

All work carried out in the vicinity of existing pipelines and associated installations shall comply with safety precautions and Company safety practices.

## III.5 CLEARING, GRADING AND BACKFILLING OF ROW

After the ROW has been cleared, the Contractor shall grade the ROW to provide safe access to the pipeline during construction.

Contractor shall grade the ROW to remove sharp, high points, to minimize bending and to maximize laying within the limits permissible for elastic bending.

Where the construction ROW follows or crosses roads, tracks, overhead power lines, plantations or any other improved or confined areas, Contractor shall grade only the width of the ROW necessary for excavating the pipeline trench. In areas where the construction activities require a greater width, Contractor shall obtain prior approval from Company/ authorities having jurisdiction before commencing any clearing operations.

Contractor shall maintain and preserve survey monuments already staked on the ground such as bench marks and intersection/ turning points until the construction operations are completed. Contractor shall re-establish missing bench marks, as directed by the Company, to allow accurate levels to be taken during pipe laying or as-built survey of the pipeline.

Contractor shall carry out all pipeline survey and levelling of line and grades including as-built survey necessary to complete the work and shall be responsible for the accuracy of such survey and final grades level.

The stakes installed by Contractor to define ROW boundary and pipeline centreline for purposes of clearing and grading operation shall be maintained throughout construction.

Contractor shall install distinct markers, approved by Company, for identifying special points and their respective chainage. The markers shall be used for but not limited to identifying contract limits, warning notices, foreign services and special crossings, change of wall thickness and above ground installations etc.

The type of markers and material used shall be approved by the Company so as to serve their purpose. Contractor shall be responsible for the maintenance and replacement of the reference line markers until the permanent pipeline markers are placed and the as-built drawings are approved.

In case pipeline installation in existing corridor, grading of ROW can be waived off pending Company approval.

### III.5.1 Fences and Barriers

Contractor shall install suitable warning tapes or trench mesh to the satisfaction of Company on either side of ROW where it is essential to ensure safety and non-interference, especially in industrial or in inhabited areas, etc., or in the proximity of roads or other installations.

Contractor shall provide and install heavy grade concrete barriers at any location where traffic might accidentally encroach on the construction.

Fencing and barriers shall be continuously maintained.

Contractor shall note that vehicles use a number of the tracks that cross (and obstruct) the ROW and that provision will be necessary for these activities to continue with the minimum of delay. Permits from the authorities will be necessary even for brief closures of these tracks. Diversions shall be as per section III.5.6.

On completion of construction, the Contractor shall restore any damaged or relocated fencing on camel compounds, pipeline corridors, and property boundaries to their original condition. Contractor shall be liable for any damage, claims or actions arising from breaches made in existing fences.

### III.5.2 Removal of Debris

Contractor shall remove all debris, timber, rock and similar material dislodged from the ROW and progressively dispose of it in a manner and method satisfactory to Company and government authorities having jurisdiction over the areas concerned. Contractor shall be responsible for all surplus material disposals, arising out of clearing and grading operations.

### III.5.3 Grading of ROW

Clearing of the ROW shall be carried out in conjunction with the construction of the access roads. Contractor shall grade the ROW and construct access road to allow the safe movement of loaded trucks and equipment without causing undue wear and tear of graded surface.

Contractor shall cut sand dunes to allow vehicle access and safe laying of the pipeline within its elastic limit. Fill material shall be installed on the ROW as required for vehicle access. Contractor shall grade and construct the ROW to ensure the trench is excavated to follow the general profile of the ROW whilst maintaining the minimum cover requirements. Free spans shall be avoided where possible.

While grading the ROW, Contractor shall consider the level of any nearby existing or planned road/ future development, which will affect the pipeline level when laid. Pipeline level should be below the level of such facilities/ utilities.

Contractor shall construct all temporary accesses such as ramps, temporary bridges, etc., to enable plant, equipment and personnel to cross any obstruction safely and efficiently. The temporary accesses shall permit continuous use of vehicles and construction traffic to preserve the banks and structure of the crossings. Existing crossings shall not be filled or otherwise obstructed without approval of the person or authority having effective control or ownership over such crossings. Prior to commencing the work Contractor shall furnish to the Company with the respective approval, notices.

Contractor shall take Company approval when the ROW is required to cross existing pipelines meeting the requirements specified in section 16.4. Contractor shall collect design data for existing pipeline from asset operations & engineering as appropriate.

### III.5.4 Restricted ROW

When the ROW passes through plantations, public roads, electric power lines or other restricted areas, the available ROW shall be limited to minimum width required for the actual trench excavation and construction of the pipeline and maintenance road. Contractor shall perform the work in such a manner so as not to cause damage to any tree or plantation, public road and overhead power lines during the construction activities.

Contractor shall also adopt a restricted ROW when the new pipeline crosses existing above ground or buried pipelines, third party property, roads, cables, and other such items. Contractor shall perform work in such a manner as not to interrupt the operations or cause damage to the existing pipeline or other such services.

Contractor shall not be entitled to extra compensation for the hardship and/ or increased costs caused by the construction areas being adjacent to or in sand dunes or other difficult terrain, construction across roads, berms, flooded areas, communication structures, wires, cables, other pipelines, overhead power lines, plantations, farms or other obstacles, which may physically restrict or limit the use of the ROW provided. Contractor shall note such restrictive features of the ROW and include an allowance for all necessary construction costs (e.g. directional drilling) under plantation and highways in the CONTRACT Price.

### III.5.5 ROW Damages

Contractor shall be liable for any and all remedial work necessary as a result of damage to existing pipelines and associated equipment, tracks, roads, highways, and all other utilities, etc., caused by him during execution of the works. Contractor agrees to carry out such works as and when required by this specification, and/ or by the Company without any cost impact.

### III.5.6 Provision of Diversions

At locations where any part of the work is routed along, over, under or across tracks, roads or highways, Contractor shall, as part of his scope of work, provide and maintain diversions, temporary bridges and traffic controls including warning lights as may be required by the respective authorities. The work shall also include permanent diversions required due to site conditions and as directed by Company.

Public travel shall not be unnecessarily inconvenienced nor shall it be wholly obstructed at any point during Construction activities.

Contractor shall provide at no extra cost, watchmen at any location where safety and work operations justify their use, or where called for by the Company. In addition, Contractor shall also provide and maintain detours, suitable lighting, barricades, adequate advance warning signs, wherever necessary, to fully protect the public and facilitate the smooth running of the contract.

### III.5.7 ROW in Sand Dune and Sandy Areas

Contractor shall grade the ROW through sand dune and sandy areas to the satisfaction of the Company. The graded profile shall generally follow the profile of the natural terrain with some alterations to ease construction of the pipeline and also ensure safe bending and laying operations, while complying with maximum allowed angle per upheaval buckling calculations.

The necessary cutting of high sand dunes shall be performed whilst grading the ROW. The cut material shall be spread to both sides of the ROW minimising the filling of low areas.

The trench shall follow the general profile of the ROW whilst maintaining the minimum cover requirements. Localised sand dunes along the pipeline corridor and sand dunes in close proximity to the pipeline route shall be removed by the Contractor as a part of his scope of work whilst preparing the ROW.

### III.5.8 ROW in Sabkha Areas

The entire ROW in Sabkha areas shall be constructed using gatch material which shall be consolidated by compaction. The type of fill material used shall be approved by Company. Following consolidation the Contractor shall provide a clear ROW as specified in the typical drawings. The finished level of the compacted fill material shall be not less than 1 metre above the existing ground level in accordance with typical drawings. Company shall approve preparation and construction of the ROW through Sabkha area as construction activities proceed.

### III.5.9 Gatch Material

Contractor shall supply gatch material as required for construction of pipeline berm etc. The gatch material used for preparation and stabilisation of the ROW shall be approved by Company prior to its use. The gatch material mixed with water and compacted shall produce a firm, solid material mass. The compacted surface layer of gatch shall not contain loose gatch and shall not break nor erode during normal use and exposure to normal environmental conditions. Contractor shall arrange to locate the source of gatch material and obtain Company approval for the use of that particular gatch material.

Prior to any abstraction of the gatch from any source, Contractor shall obtain the necessary approvals from all concerned authorities.

### III.5.10 Pipeline Re-Routes

Contractor shall carry out as part of his scope of work, all work associated with, any local realignment of the pipeline route and/ or design modifications as directed by the local statutory authorities or as required due to actual site conditions, recent developments or the presence of any underground structure or utility found during excavation. Any resulting impact to the overall length of the pipeline shall be adjusted in accordance with the provisions of the agreement. Contractor shall be responsible for obtaining all required approvals from statutory authorities for any pipeline re-route.

### III.5.11 Construction in Sabkha

In Sabkha areas, preparation and construction of ROW shall be made to a minimum finished level of 0.75m above the natural Sabkha ground level.

The pipeline shall be positioned on the compacted layer of bund material as shown in the typical drawings (30-99-22-0006 (AON) sheet 13). The compacted layer of bund material shall have a minimum thickness of 750 mm from centre of pipe to grade level. However for pipe sizes > 20” NPS, the compacted layer under pipe shall provide a minimum thickness of 750mm from bottom of pipe to grade level. The pipe shall be provided with bedding of 150 mm below the pipe. Following installation, pipeline shall be padded with soft sand to a height of 150 mm around the pipe and backfilled with approved material (free of stone, and size shall not be over 75 mm).

The berm shall provide a minimum cover of 1m (including gatch cap), measured from top of the pipe. The berm fill material shall be wetted, rammed and compacted. Method and degree of compaction shall be subject to approval by Company. The berm shall be capped with a 0.5 m layer of approved gatch material.

In the event of crossing with existing pipeline in Sabkha area installed on a bund, the new pipeline shall cross the existing pipeline with minimum 1m clearance under the existing pipeline. Crossing arrangement in Sabkha area shall be as shown in typical drawing (30-99-22-0006 (AON) sheet 13).

In case of open cut crossing such as rig road, corridors and any other crossing, Contractor shall check the pipeline buoyancy in Sabkha and provide proper measures to the pipeline stability.

The required density for bund material shall not be less than 95 percent standard proctor density, obtained by compaction in layers of 300mm by suitable means. For the berm area, the standard proctor density shall not less than 80%.

Prior to compaction, water shall be sprayed on the placed material to achieve the optimum moisture contents.

### III.5.12 Access to ROW

Access to the ROW shall be from existing roads where such roads cross the ROW or via access roads constructed during the works.

For aboveground pipelines, the ROW of existing pipelines shall not be used for access to the work area. Where it is necessary to construct a temporary ROW crossing over an existing service, it shall be hand-dug to expose the service and verify the cover. Proposals for approval of such ROW crossings shall be submitted to Company prior to commencement of works.

For buried pipelines, the ROW of existing pipelines can be used for access to the work area subject to meeting the requirements specified in section III.10.4.

Care shall be taken to avoid damage to existing roads and other above ground features. Special provisions shall be made when construction equipment is required to cross existing roads during installation of the pipelines. Any damage shall be repaired without delay for all road surfaces and other above ground features damaged during the performance of the works and they shall be restored to the same state as before the damage occurred.

Access road shall be identified, approved, marked and documented.

## III.6 HANDLING, HAULING, STRINGING AND STORAGE

Contractor shall be responsible for handling, hauling, stockpiling, storage and stringing of the coated line pipes as per project specification, which is to be developed by the Contractor.

### III.6.1 Handling of Pipes and Fittings

Contractor shall provide suitable and sufficient trucks and equipment to transport the line pipe safely and efficiently in such a manner that prevents damage to both the coating and line pipe.

All Submerged Arc Weld (SAW) pipes and fittings, either bare or coated pipes, shall be handled in the way that seam welds shall always in 2, 4, 8 or 10 O'clock positions during loading, unloading and transportations.

Pipe and factory bends shall be adequately restrained, padded and secured in position, in a manner approved by the Company, during transportation, stringing operations and during storage at pipe dumps.

Factory bends, which made of SAW mother pipes, shall be handled where seam welds always on top. No factory bends with seam weld shall be transported and stored with its seam on the bottom.

Non-metallic, soft and clean surface spacers shall be utilized during transportation from pipe mills to coating yards and up to line pipes stringing at site.

Pipes shall be clearly marked and stacked separately according to diameter and wall thickness. Under no circumstances shall any stack contain pipes of different wall thicknesses.

During lifting operations, Contractor shall ensure pipes are not allowed to drop or strike objects, which will damage the pipe or coatings. The pipes shall be lifted or lowered from one level to another, using suitably rated

and certified equipment. Lifting hooks, when used, shall be equipped with a plate bent to fit the curvature of the pipe and which shall be fitted with a soft insert to prevent damage to the pipe wall or bevelled ends.

During hoisting operations, the included angle of the wire ropes shall be large enough to prevent the wire ropes coming into contact with the external coating, whilst still maintaining a safe lift. Rolling, skidding or dragging of pipes shall be strictly forbidden.

Handling of coated pipes shall be carried out using flat slings and belts, minimum width of 150 mm, made from non-metallic/ non-abrasive materials. The use of round sectional slings is prohibited.

Pipes shall, at all times, be stacked clear of the ground by at least 150 mm to ensure the bottom row of pipes remain free from surface water contact. The stacked pipes shall be inclined to prevent driving rain collecting inside the pipe.

The coated pipes shall be stacked on layers of soft, stone free sand (or soft sand bags) and covered with a plastic film or on wooden supports provided with suitable cover. The supports shall be spaced in such a manner as to avoid permanent bending of the pipes, particularly when stacking thin wall pipes. The pipes shall be stacked so that the uncoated bevelled ends are in line at one end, thus making differences in lengths clearly noticeable.

The coated pipes shall be stacked in a manner and to a height approved by the Company and manufacturer's recommendations. Each pipe shall be separated by means of spacers suitably spaced to enable safe lifting of the pipes without damaging the coatings. Stacks shall consist of pipe sections having the same diameter, wall thickness and manufacturer.

All coated pipes stacked in open storage yards or stock piled shall be suitably covered, as approved by the Company, to reduce exposure to direct sunlight. During handling and stacking, Contractor shall ensure all pipe ends shall be protected with the bevel protectors. Contractor shall replace any bevel protectors found to be missing.

Contractor shall obtain written instructions from the line pipes and fittings manufacturers for the stacking requirements for each item.

Lorries transporting the line pipe shall be equipped with cradle type pipe supports lined with a soft non-abrasive rubber material to secure the pipes and prevent coating damage during transit. Each pipe length shall be loaded into individual cradles and secured to the trailer/ lorry using web type slings. Loading and transportation of pipes without the cradle supports is prohibited. The cradles shall be positioned to support equal loads exerted from the pipe whilst providing support for at least 10 percent of the pipe length. The rubber protection shall be free from all nails and staples where in contact with the pipes. The second row of pipes and all subsequent rows shall be separated from each other using protective cushion pads, such as compressed straw in plastic covers, mineral wool strips, rubber belts or other Contractor approved protection, to avoid direct contact between the coated pipes.

All lorry trailer stanchions used for pipe transportation shall be covered with a soft non-abrasive rubber material such as rubber belts or equivalent. Contractor shall take extra care to properly cover the stanchion tops and any other exposed sharp edges of the trailer body to prevent damage to the line pipe coated surface following accidental contact.

Prior to receipt of the line pipe, Contractor shall submit for Company approval, a comprehensive handling, storage and transportation procedure detailing the methods and equipment to be used for handling and stacking of coated pipes at least 21 days prior to commencement of handling operations.

### III.6.2 Hauling and Stringing of Pipe

Pipe shall be unloaded from the stringing trucks and lowered onto the ground using side booms, telescopic mobile crane or other suitable equipment approved by the Company.

All pipelines to be installed in the same trench are to be strung at the same time. Sufficient space shall be provided between strings to enable welding operations to be carried out concurrently. Contractor shall prepare a method statement for stringing of multiple pipelines in a single trench for Company approval.

For SAW pipeline, Contractor shall assure that seam welds of the strung line pipes shall be on the upper positions from 10 to 2 O'clock.

Pipes shall be strung alongside the trench on supports properly spaced with the pipe cleared off the ground.

The pipes shall be strung at a suitable and constant distance from the centre line of the trench/route. Stringing on the ROW shall be carried out in such a manner as to minimise interference to trucks normally using the access tracks crossing the ROW.

Contractor shall leave gaps at regular intervals or wherever requested by other users to permit the passage for traffic or equipment across the ROW and along public roads or highways. Pipe stringing shall be carried out in such a manner as not to cause a hazard or possible damage to the public and local traffic.

All coated pipes strung on the ROW shall be supported in such a manner that each pipe is free from contact with the ground at all times. Sand bags, as approved by the Company may be used as pipe supports except in wet areas. In wet areas, wooden skids shall be used, as approved by the Company.

Contractor shall track each individual pipe by recording the pipe number, steel heat number, pipe length, wall thickness and location, throughout the stringing operation.

The pipe tracking records shall be updated to "As-Built" as construction progresses and shall include the weld numbers, welding operator's identification number and location of each weld. The final "As-Built" records shall be submitted to the Company following completion of the welding and NDT operations.

Pipes shall not be strung on the ROW more than 3 (three) kilometres in advance of the mainline welding, unless specifically permitted in writing by the Company.

Pipe ends shall be protected with plastic end covers to prevent ingress of sand and construction debris whilst the pipes are strung along the ROW.

### III.6.3 Damaged Pipes

Once the pipes have been strung, the Company and Contractor's representatives shall jointly inspect each individual pipe. All defective pipe ends shall be noted and repaired. Defective pipe shall be noted and repaired or rejected as directed by the Company.

Rejected pipes shall be quarantined and stored by Contractor away from the ROW until completion of the WORK, when all quarantined pipe shall be transported to Company stores.

### III.6.4 Pipe Offcuts

Where pipes are cut, all pieces shall be clearly and permanently marked with the original pipe number. All offcuts in excess of 1.5m in length shall be immediately re-bevelled and carried forward to be welded into the line at an appropriate location, which shall be recorded on the as-built records.

### III.6.5 Care of Other Materials

Materials supplied by the Contractor and associated with pipeline construction, such as field joint coatings, fibre optic cables, etc., shall be properly stored in a safe & secure area and shall not be stored on the ROW. When required the materials shall be transported onto the ROW in covered vehicles and delivered direct to the desired location. Provision of all storage areas, buildings, sheds and associated services shall be the responsibility of the Contractor.

Coating materials shall be suitably stored and protected, in accordance with the Manufacturer's recommendations, to prevent deterioration as a result of exposure to high temperatures and adverse environmental conditions. Deteriorated materials and materials with an expired shelf life shall not be used but shall be removed from the site. Contractor shall replace all such materials at no cost to the Company and shall dispose of the materials in accordance with local Authority and Company procedures.

During loading, unloading, storage and use, the materials mentioned above shall always be handled with care and in accordance with the manufacturer's recommendations, to prevent deterioration, adulteration or dispersion and health hazard to human beings or livestock or any other form of damage. When supplied in containers and envelopes, they shall not be dropped or thrown, or lifted using hooks during handling operations. The containers shall only be disposed of in accordance with procedures approved by the Company and Local Authorities.

Contractor shall ensure the materials that are sensitive to the adverse environmental conditions remain free from contact and contamination with water, mud, sand, earth, dust, crushed stone and any other foreign material during unloading, transport and application operations.

Volatile materials, which are susceptible to change in properties and primary characteristics, when stored incorrectly, shall be stored in strict accordance with the Manufacturer's instructions and recommendations. Contractor shall pay particular attention to the temperature and humidity in the storage facilities.

Materials liable to corrosion whilst in storage shall be treated in accordance with the Manufacturer's recommendations. In the absence of such instructions, the Contractor shall exercise proper care and diligence including the application of an appropriate preservative to the affected components.
Flammable materials shall be stored in special safe storage locations in accordance with Company and Local Authority procedures.

## III.7 TRENCHING

### III.7.1 Excavation

Contractor shall excavate the pipeline trench as per the AFC (Approved for Construction) pipeline alignment sheets/ drawings. The methods used to excavate the pipeline trench shall be approved by Company. Trenching operations shall not commence until the staked pipeline centreline has been approved by the Company.
Contractor shall excavate the pipeline trench on the cleared and graded ROW using any method approved by the Company. Care shall be exercised to ensure that fresh material recovered from trenching operations, intended for back filling over the pipe in the trench or on berms, is not mixed with loose debris or other foreign material.

### III.7.2 Trenching in Sand Dunes

Where the pipeline is to be laid in sand dunes, the trench shall be cut to ensure the minimum depth and width at the trench bottom is in accordance with the AFC alignment sheets and/ or drawings.

### III.7.3 Trench Dimensions

Normally, the trench shall be excavated to a minimum width so as to provide, on both sides of the installed pipeline, the minimum clearance of 200mm at the trench bottom as indicated on the Typical Drawings and to a depth sufficient to provide the minimum padded sand bedding of 150mm and the minimum cover referenced in this Specification.

The side slope for trench shall be less than the angle of repose for the soil type to avoid collapse of trench sides. Contractor shall adopt suitable measures for protection of excavated trench by means of suitable temporary barriers, dewatering, trench protection etc.

The dimensions referenced in this Specification and on the Typical Drawings shall be strictly adhered to except where otherwise specified or detailed on the Company approved pipeline alignment sheets/ drawings.

### III.7.4 Minimum Cover Requirements for Buried Pipeline

The cover shall be measured from the top of the coated pipe, after it has been laid in the trench or placed on the formation level, to the level of the original ground or graded ROW profile in areas of cut, excluding ditch crown/ berm. The required values are given in section II.5.11.

### III.7.5 Extra Depth and Clearances

Contractor shall excavate to extra depth where the pipeline approaches and crosses other pipelines, sewers, drains, water mains, telephone cables and other underground services. The pipeline shall be laid to a depth so that the top of the pipeline is at least 1 meter below the bottom of the existing facility (pipeline/ cable, etc.). If greater minimum distances are required by the relevant authorities or owners, those distances shall be met.

Contractor shall extent of the pipeline burial depth in the last 200m approach to the stations and wells by at least 1.5m from the grade level and it is important to notice that the berm height shall not countable as extra backfilling of the pipeline.

Where the pipeline crosses areas where easements specifically require extra depth of cover, the trench shall be excavated to the extra depth as required. The bottom of the ditch shall be gradually sloped to accommodate the increased depth.

For all road crossings and existing pipeline crossings an extra deep trench shall be required. The minimum cover required as defined in this specification or on appropriate standard Typical Drawings or other drawings shall be strictly followed.

Contractor shall excavate all such additional depths, as necessary, at no extra cost to the Company.

### III.7.6 Protection of Underground Utilities

Where the new pipeline routes follow existing facilities, the Contractor shall ensure the safety and protection of these existing facilities. Contractor shall co-ordinate closely with relevant Operations Departments/ Services during all construction phases particularly during excavation work. Contractor shall obtain all requirements of the Owner/ Authority for the facilities/ Services and shall strictly comply with these requirements during all phases of pipeline construction with no extra cost and/ or time implication to Company. All safety requirements highlighted by Operation Departments while issuing work permit(s) shall be strictly followed by Contractor as part of his Scope of Work.

Details of underground utilities, where known, will be indicated on the pipeline construction drawings. However, Contractor shall make reasonable efforts to obtain plans and full details of all existing and planned underground services from the relevant Local Authorities and Facility Operators. Contractor shall follow these plans closely

at all times during execution of the work and shall be responsible for location and protection of all underground lines and structures, whether shown on the drawings or not. Contractor shall use high resolution pipeline locators and all other means including manual excavation for locating the pipelines, utilities and substructures, etc., as a part of his Scope of Work. All underground facilities shall be marked on the as-built drawings.

In special locations, as specified by the Company and/ or Local Authorities, where the use of trenching machines or backhoes may result in unnecessary damage to property and subsurface structures during excavation, the Contractor shall excavate the trench manually as part of his Scope of Work. In all other areas where the pipeline crosses underground services and structures, the Contractor shall, prior to commencing trench excavation, hand excavate to expose the services and structures, and clearly mark on as-built drawings the type, diameter, horizontal and vertical position and angle of the services and structures relative to the new pipeline.

Also, the equipment / vehicles used during construction of new pipelines shall not be allowed to stand on the existing buried pipelines.

Temporary underpinning or any other supports and protective devices necessary to protect the structure from damage shall be provided by the Contractor.

Contractor shall support the services and structures crossed both above and/ or below ground as necessary to prevent any damage.

If, despite all precautions, any damage should occur to any services and/ or structures etc., the Contractor shall immediately contact the applicable Owner/ Authority. Replacement/ repair and reinstatement of the damaged service and/ or structure shall be carried out by the Contractor at his expense under the direction and to the satisfaction of the Owner/ Authority. If Contractor fails to complete the repairs or replacement in reasonable time, Company reserves the right to have the repair/ replacement completed by others and all associated costs shall be charged to Contractor's account. In some cases Owner/ Authority may wish to repair the damage by themselves. Under such situations, all cost associated with repair shall be reimbursed by Contractor to the respective Owner/ Authority.

In addition to temporary protection, Contractor shall also provide all permanent protection measures to cables, services and existing pipelines crossed by the new pipeline. All permanent protection measures shall be in accordance with requirements imposed by the applicable Owners/ Authorities.

Such works shall not be limited to providing additional gatch, coating, sleeve and concreting. Permanent protection works are required for telephone and high voltage Power cables.

All protection works on ETISALAT/Du telephone cables and high voltage power cables etc., shall be carried out under the direct supervision of the applicable Owner/ Authority or when required, this Work shall be carried out directly by the Owner/ Authority on a reimbursable cost basis. Contractor shall coordinate all activities associated with the protection works directly with the applicable Owner/ Authority. Company shall not be subject to any additional costs associated with these activities.

Wherever is necessary and following clearance from the statutory authorities concerned, Contractor shall arrange to re-route the services. The re-routing shall be carried out, subject to prior agreement, by the Contractor or an approved sub-contractor nominated by the Statutory Authority. Contractor shall be responsible for all costs associated with re-routing of services.

### III.7.7 Grading, Padding and Finish of Trench or Formation

The trench or formation shall be cut or made to a grade that shall provide a firm, uniform and continuous support for the pipe. Changes in direction or elevation where possible should utilise the elastic bending of the pipeline. Bends shall only be made in the pipe at significant changes in grade of the trench.

Contractor shall reduce to a minimum the required number of cold field bends to lay the pipe to conform to the general contour of the ground and maintain a normal cover. This can be accomplished by cutting the trench slightly deeper at the crest of ridges and by gradually deepening the trench in approaches to road crossings and small water courses. Such trenching work shall be done by the Contractor as part of his scope of work.

Hand grading of the trench bottom shall be minimised. To achieve this, Contractor shall dig the trench bottom as square as possible with his equipment. Hand excavation in the trench shall be limited to removal of loose rock and/ or hard lumps of material.

In all cases where rock, gravel or hard material is encountered on the trench bottom or on filled ROW (where the pipeline is laid on filled ROW), the Company shall determine the extent of padding that is required. Compacted thickness of the padding shall not be less than 150 mm. In areas that are to be padded, the trench shall be at least 150 mm deeper than normally required, evenly and sufficiently padded to keep the laid pipeline at least 150 mm above the bottom of the excavated trench.

Acceptable padding, as approved by the Company, shall be placed in the trench prior to installation of the pipeline and around the pipeline following installation. This shall ensure that both the sides and top of pipe remain surrounded by a permanent layer of padding. The compacted layer of padding on top of the pipe corrosion coating shall be at least 150 mm. Padding materials that are approved by Company shall be sand containing no gravel, rock or lumps of hard material.

### III.7.8 Trench Crossings

Where the trench is cut across existing access roads or tracks, Contractor shall, in cases where a diversion is not practical, install adequate temporary bridges to support the full width of the roads or tracks. The temporary bridges shall be of adequate strength and properly constructed to ensure public safety and allow passage of normal traffic with minimum inconvenience and interruption. Where practicable, Contractor may also propose suitable alternative routes that shall however, have no cost impact to the Company business continuity.
Wherever deemed necessary by the Company, Contractor shall arrange to complete the trenching, laying and backfilling of such crossings and to remove the temporary bridging before the end of the regular work day in order to minimise the potential hazard to night traffic.

Contractor shall obtain the necessary permission, in writing, from the relevant authorities before commencing any work and shall ensure that all regulations and requirements of that Authority are complied with. Contractor shall provide and maintain proper warning signs, which comply with current Highway Authority standards while the crossings are open. If such crossings are open at night, Contractor shall provide and use warning lights of a type approved by the Company and the relevant Authorities.

### III.7.9 Protection of Trench and Boring Pits

Contractor shall maintain the trench and pits in good condition throughout the duration of the pipeline installation works. Company shall not be liable for any claim by the Contractor for the collapse or caving of the trench sides before, during or following pipeline laying operations. Contractor shall supply, install and subsequently remove all materials necessary to support or shore the trench and pit sides to prevent collapse or caving.

Contractor shall provide adequately sized de-watering equipment, shoring and any other equipment and materials necessary to safely excavate and/ or support the trenches and pits. Contractor shall install the pipe and backfill the excavations in accordance with this Specification and the Drawings. All excavations shall be carried out in dry conditions and maintained in a dry condition throughout the duration of the pipeline installation works and until completion of backfill operations.

Where the pipeline is laid close to existing pipelines, Contractor shall comply with the requirements of the Owner/ Operator of the existing pipeline, with particular emphasis to safety, procedures and additional protection, etc. as a part of his scope of work.

## III.8 PIPE BENDS

Where possible, Contractor shall provide for changes of vertical and horizontal alignment by elastic flexing of the pipeline. Contractor may provide cold field bends (R = 40D or larger radius as appropriate and as per stress analysis minimum requirements) at his option for changes of direction and changes of slope. Use of hot bends (R = 10D for ≤ 4" size and R = 5D for ≥ 6" size) shall be minimised and shall be restricted to locations where such bends are required due to a space/ level constraint and after all other options have been exhausted.

The tangent length for induction bends shall be minimum 1 metre for each end. Over bends shall be made in such a manner that the centre of the bend clears the high points of the trench bottom. Sag bends shall fit the bottom of the trench and side bends shall conform and leave clearance to the outside wall of the trench.

### III.8.1 Elastic Bends

The minimum allowable radius for elastic bends in the buried sections of pipeline shall be based on the maximum allowable bending and combined stress specified in the applicable Pipeline Design Code / project pipeline design basis. The elastic bend shall be continuously supported over its entire length.

Any bend radius with less than the permitted elastic bend minimum shall be produced using an approved cold field bending technique. The bend radius for the elastic bend shall not be less than the minimum radius of curvature specified in the pipeline alignment sheet and relevant mechanical design report.

### III.8.2 Cold Field Bends

Cold Bends shall be produced using a cold, smooth-stretch technique utilising purpose built equipment as approved by the Company, in such a manner as to preserve the cross-sectional shape of the pipe. Under no circumstances shall heat be used for the purpose of bending the pipe. Contractor shall perform cold bending calculations based on bending machine capabilities, pipeline size, wall thickness, strength etc. and identifying the maximum allowable bend angle per double random length.

The cold bends radius shall not be less than 40 times the pipe nominal diameter and maximum bend angle shall not exceed 45º per double random length (12m).

Utilizing of SAW line pipes for field bends shall be carried out very carefully as the weld seam location shall be in the neutral axis of the bend. Full inspection of weld seam by UT scan or other suitable NDT method shall be carried out for each field bend and the inspection results shall be submitted to Company for review and approval.

Pipeline change of directions shall be made of composite bend segments (12 m each) based on the maximum allowable bend angle per each segment of 12m length.

Contractor shall use the correct size bending machine and mandrel and adopt recognised and accepted methods for bending coated pipe in accordance with good pipeline construction practice. The bending machine shall be of a type approved by the Company.

Bending machines shall be capable of making bends without wrinkles, buckles, stretching and with minimum damage to the coating. Any damage to the coating shall be repaired by the Contractor.

Prior to commencement of the work, Contractor shall submit and demonstrate to the Company a bending procedure, which shall conform to the recommendations of the Manufacturer of the bending machine. The procedure shall include lengths, maximum degree per pull and the method and accuracy of measurement during pulling of the bend. The procedure and equipment used shall be subject to Company approval.

Pipes with longitudinal welds shall be bent in such a way that the longitudinal weld lies in a plane through the neutral axis of the bend. The pipe shall be installed positioning the longitudinal weld in the upper quadrants. If

horizontal deviations are to be achieved by joining two or more adjacent bends, then bending of the pipe lengths shall be made by positioning the longitudinal welds alternately 70 mm both sides of the plane passing through the neutral axis. This shall ensure that the bends are welded with the longitudinal welds displaced by about 150 mm and situated in the upper quadrants. Where vertical bends are to be formed by joining two or more adjacent bends, the longitudinal welds shall be positioned alternately to the left and right of the plane passing through the neutral axis.

The pads, dies and rolls of the bending equipment shall have relatively soft surfaces to avoid damage to the line pipe coating. Where applicable, fully retaining bending shoes shall be used. Roller-type bending machines are preferred.

The tangent ends of each bend shall be straight and shall not have been subjected in any way to the cold bending operation. The length of the straight section shall be preserved to permit ease of alignment and field welding. Under no circumstances shall the start / end of the bend be any closer than 1.5 m from the pipe end girth weld.

Ovalisation of a cold field bend shall not exceed 2.5 percent of the nominal pipeline diameter at any point. Ovalisation is defined as the reduction or increase in the internal diameter of the pipe compared with the nominal internal diameter. Contractor shall carry out a dimensional check on all bends, by passing a gauge consisting of two discs of diameter equal to 95 percent of the nominal internal diameter of the pipe, connected rigidly together at a distance of 350 mm. The dimensional checks shall be carried out and witnessed by the Company during each cold bending operation.

### III.8.3 Mitre and Unsatisfactory Bends

All cold-field bends showing any signs of buckling, wrinkles, cracks or other visible defects or which are in any way in conflict, in whole or in part, with this Specification shall be rejected.

Under no circumstances shall mitre bends be used during construction of the pipeline. Contractor shall cut out and remove any bend or bends, which do not meet the requirements of this Specification and shall replace the same with satisfactory bends at no cost to the Company. All material required for replacement shall be supplied by the Contractor. Cutting of factory made bends and cold field bends for any purpose is not permitted without Company approval.

## III.9 LINING UP

### III.9.1 Care of Pipe

Contractor shall lay out and measure the pipe to minimise the number of cut lengths less than 1.5 meters long.

Where possible Contractor shall cut the pipes at tie-ins, etc., to ensure the off-cuts are greater than 2 m in length. The off-cuts shall be moved forward and used for completing welded connections between the positioned pipelines instead of cutting lengths from long pipe spools for this purpose. The original pipe number and location shall be recorded in the as-built records.

Notwithstanding the above, the minimum distance between any two circumferential welds shall be 1.5m and there shall be no more than three (3) circumferential welds in any eight (8) meter run.

### III.9.2 Pipe Defects and Repairs

Contractor shall be responsible for the repair or removal of all internal and/ or external pipe defects as directed by Company.

The acceptance criteria for all defects detected in the line pipe during routine site inspections shall be in accordance with the latest editions of ADCO Specifications, API 5L, ISO 3183, ASME B31.4/ 31.8 and the relevant Project Specifications, whichever is the more stringent.

The maximum permissible dent depth in pipe is 2 percent of the nominal pipe diameter. Each dent shall be subject to a thorough visual examination and shall be inspected by means of Non-destructive Testing (NDT) for the presence of any cracks.

Dents which contain a scratch, gouge, arc burn or sharp groove and dents located at the longitudinal or circumferential weld seam shall be removed by cutting out the damaged section of pipe and replacing with a minimum 2D length of line pipe or 1.5 m, whichever is higher.

Repairs to the line pipe shall be executed in accordance with this Specification, the Codes and Standards referenced in Section 2 and the Design General Specifications.

Contractor shall maintain a record of all line pipe repairs containing the pipe identification numbers. This repair record shall be submitted to the Company.

Before any cutting or repair, the pipe identification shall be transferred by Contractor in the presence of Company to any portion other than that to be cut off. Any pipe without identification number shall not be transported and/ or welded in the pipeline, but shall be removed from the site.

### III.9.3 Swabbing, Pipe Beveling and Cleaning Ends of Joints

Prior to aligning pipes for welding, each length of pipe shall be thoroughly surface inspected both internally and externally to ensure that they are 100% free from any visual defects and/ or damage, severe local corrosion or corrosion pitting, dirt, animals or any other foreign objects. Immediately before welding each length of the pipe shall be adequately swabbed using a leather or canvas belt disc having the correct diameter (not less than the pipe I.D. plus 1 cm) or by any other suitable methods approved by the Company.

If the surface defects can't be removed as per API 5L / ISO 3183 recommended methods, damaged and/ or corroded pipes shall be quarantined and removed from the site. Prior to welding operations, the concentricity of each length of pipe shall be checked by pulling through a gauging plate, sized to the satisfaction of the Company.

Immediately prior to aligning pipe for welding, the bevelled ends of each joint of pipe and the area 25 mm (minimum) cutback from the weld bevel, both inside and outside, shall be thoroughly cleaned of paint, rust, mill scale, dirt or other foreign material using power-driven, wire-buffing brushes, or by other methods approved by the Company.

All damaged pipe ends that in the opinion of the Company will result in poor alignment or poor quality welding, shall be repaired or removed. The pipe ends shall be re-bevelled to the correct angle using a bevelling machine of a type approved by the Company.

Contractor shall remove dents from the weld bevel with a depth less than 1 mm during the cleaning and grinding operations. Where the dent depth in the bevel end is between 1 and 3 mm, Contractor shall re-bevel the pipe end. Dents over 3mm shall be repaired by removing the bevel end and re-bevelling the cut section of pipe.

Repair of damaged pipe ends by hammering and/ or heating is not allowed.

### III.9.4 Pipe Handling and Skid Supports

When lifting pipe, care must be taken not to kink or overstress the pipe. Proper pipe slings of a type approved by the Company shall be utilised during all lifting operations. All lifting equipment, including but not limited to,

slings, shackles, spreader beams and chains, shall have current, valid safety certification, copies of which shall be available to the Company for inspection. Damaged slings shall not be used, but shall be removed from the site. Certified belts with clean, free from hard material and smooth surface shall be utilized for the lifting of the coated and uncoated pipes.

Contractor shall submit, for Company approval, proposals detailing the type of skid supports and the spacing of skids to be utilised during construction operations. A strip of soft material shall be placed on the top surface of the skid to protect the line pipe factory applied coating. The protective material shall be approved by the Company.

Skids shall be at least 1.2 m in length. The skids supporting the pipe shall have a minimum width of 200 mm. The skidded pipe supports shall be sufficiently stable to allow movement of the pipe without causing the supports to move or become unstable. The skid supports shall be capable of supporting both axial and tangential movement, due to line pipe expansion, without any danger of the pipeline falling from the supports. Skids shall not be removed from under the pipe before lowering in. The welded pipe shall be positioned on skids a minimum distance of 500 mm from the ground. Crotches shall be installed at frequent intervals (at least every 10th support) with a greater number required at bends and undulating grounds.

### III.9.5 Night Caps

At the end of each working shift, or every time joining and welding operations are interrupted, the open ends on welded pipe strings shall be capped with a securely fitting closed cap or cover of a type approved by Company. The caps shall be designed to prevent the entry of dirt, water, animals or any foreign material into the pipeline. These covers shall not be removed until the work is resumed. The caps or covers used shall be the mechanical type and shall not be attached to pipe by welding or by any other means, which may dent, scratch or score the pipe.

### III.9.6 Temporary Caps

Where welded pipe strings are to be left open for relatively long periods of time before tie-in operations commence, for example at road, ditch and foreign service crossings, etc., temporary metal caps of a type approved by Company shall be welded to the pipe ends.

## III.10 SPECIAL CROSSINGS/ ROAD CROSSINGS

### III.10.1 General

Crossing of roads and buried or aboveground services with plant, equipment and/or personnel shall only take place after the Contractor has obtained written approval from the relevant Authorities and after making provisions for safeguarding the roads, verges and buried services. The Contractor shall make available, for Company review, the written approval and shall comply fully with the restrictions and conditions referenced therein.

In accordance with Local Authority requirements, Contractor shall provide an undertaking to produce and install a competent road crossing design and shall repair & retain to original conditions any damage caused to the road or surrounding areas as a result of construction works. All remedial works shall be carried out by Contractor to the satisfaction of the relevant local Authority.

It shall be Contractor's responsibility to become familiar with all relevant requirements and regulations of the Authorities and Governmental bodies having jurisdiction over highways, roads, pipelines, overhead power cables and other foreign services, on the Right-Of-way, or crossing the Right-Of-way and to obtain their approval in provision of Drawings and Specifications of the relevant Authorities. In the event that the Authorities requirements and specifications are more stringent than the Company's, then the Authority's requirements shall be complied with at no additional cost to the Company.

Highways, Main-Roads and their verges shall not be used for loading, unloading or stacking of materials and/ or equipment. Unloading on secondary roads is only permitted after prior approval from the relevant Authorities. Contractor shall not close or divert roads without prior approval from Company and the relevant Authorities.

Road diversions, if required, shall comply with the written approval from the relevant authorities and the specifications and conditions referenced therein.

Similar to clause 12.2, seam welds of the SAW pipelines in all types of crossings shall be on the upper position 45O around 12 O'clock (i.e. between 10 & 2 O'clock) in the final laid conditions.

Contractor shall submit, for Company approval, proposals for installation of the crossings, including, the schedule, details of the methods to be used, line and level control, the type of equipment and the results of all investigations and surveys. Work on the crossing shall not commence until the proposed methods and procedures have been approved in writing and no objection has been received from the relevant Authorities concerned.

Construction of crossing shall include all necessary clearing, grading, excavating, shoring, de-watering, trenching to the required depth and widths, welding, coating, lowering, backfilling, clean up, restoration and any additional work required to complete the crossing in a safe manner.

Prior to commencing installation of the crossings, the Contractor shall provide suitable barriers, adequate traffic warning signals and/ or traffic lights and suitable diversions as directed by Company and in full compliance with relevant Authority requirements. Diversions shall not cross sections of the new and existing pipelines unless, in the Company's opinion, the pipeline is adequately protected. Rig crossing shall be installed meeting the requirements of authorities having jurisdiction. Design of Rig crossing shall be approved from these authorities before commencement of work.

Installation of the crossings shall comply with the Company approved drawings issued for construction. Contractor shall verify all crossing details provided in the design documents and investigate measures to mitigate the same, as part of his scope of work.

End of the pipe berm on either side of road crossing shall be protected with gatch or gravel up to a length of 2m to avoid erosion as per the direction of Company.

Contractor shall consider high wall thickness (design factor 0.6) at all existing facilities crossing ROW, roads and rig crossings.

### III.10.2 Minor/ Graded Road/ Track Crossings

Track and minor graded road crossings may be performed using an open cut technique, providing the necessary road closure permits can be obtained from the relevant authorities and interested Third Parties.

Rig crossing shall be constructed using an open cut technique. Crossings using the open cut technique shall be carried out in accordance with the approved Typical Drawing.

To avoid settlement in open cut crossings, the trench bottom shall be well compacted for a distance of not less than five meters beyond each side of the crossing ROW limits to provide a firm bearing. The pipe shall then be laid on the compacted trench bottom.

The track sub-surface and surface layers shall be reinstated to the satisfaction of the relevant Authority and in accordance with the referenced drawings, Specifications and requirements indicated by relevant Authorities. Steel access barriers shall be installed at all track and rig crossings to protect the installed pipeline from third party damage.

Access barriers shall be installed in accordance with the Typical Drawing No. 30-99-22-0006 (AON) Sheet.8.

### III.10.3 Major Crossing and Asphalt Road Crossings

Crossing of all major facilities and asphalt roads shall be by thrust bore drilling or HDD or micro tunnelling method subject to Company approval. Open cutting of asphalt road shall be implemented only after written permission is obtained from the Authorities having jurisdiction.

CICPA fence including its patrolling road shall be trenchless crossed by HDD method as specified in “Smart Fence Crossing Procedure” ESSS-TSD-GEN-PRD-0004 issued by ETIMAD.
It is Company’s preference for crossing asphalt and major roads using uncased boring/ jacking/ directional drilling technique.

Contractor shall not extend the trenchless crossing (HDD or others) methods outside the requirements of this specification unless a technical deviation form was approved by Company.
In order to protect the corrosion coating of the pipeline while boring, corrosion coated carrier pipes and field joints shall be additionally concrete coated to a minimum 50mm thickness. The design of concrete coating shall be submitted by Contractor for approval of Company. Contractor may propose alternative method for Company’s approval.

The crossing shall be bored using a bore pipe casing of at least the same outside diameter as the outside diameter of the concrete coated carrier pipe.

Upon completion of the bore, the proper length of road crossing carrier pipe shall be welded to the bore pipe casing and pulled into the hole taking the place of the bore pipe.

Front head of carrier pipe shall protrude at least 2 meters into the installation ditch on the opposite side so that any potentially damaged section of the pipe may be cut. If this boring operation fails, the pipes shall not be withdrawn. It shall be filled with concrete and plugged at either ends. Contractor shall, in such case, re-bore at an alternate alignment as approved by Company without any additional compensation from Company.

Contractor shall pre-test (including hydrotest) the carrier pipe installed at all major asphalt road crossings. The machines used for boring shall be of a type approved by Company. All crossing methods shall be subject to Company approval.

Drilling/ boring machine shall have position control and the profile of the pipe shall be monitored. Any horizontal/ vertical deviation which may result in overstress shall be rejected. Contractor shall submit the profile of the crossing along with stress calculation for any deviation.

A detailed design shall be prepared for each crossing and submitted to Company for approval.
Concrete Safety barriers shall be installed at all asphalt road crossings to protect the installed pipeline from third party damage. Safety barriers shall be installed in accordance with the Typical Drawing No. 30-99-22-0006 (AON) Sheet.7 and shall extend a minimum of 5 meters either side pipeline at crossing location.

If the boring operation fails the pipe shall be withdrawn and not left in the ground.

### III.10.4 Buried Pipelines Crossing other Buried Services

#### III.10.4.1 General

The new pipelines shall pass below the existing buried facilities such as pipelines, cables, and other utilities. Type of crossing shall be such that a minimum depth of cover as required in this specification and detailed drawings as per Appendix-B are complied. The minimum clearance required between new pipeline and the existing facility shall be 1000 mm. Identification slab/cable tiles shall be placed between new pipeline and existing pipeline in accordance with typical drawing.

Whatever buried services in the ROW are to be crossed by new pipeline, Contractor shall safeguard the buried facilities and the required protecting precaution shall be executed as approved by Owners of the buried services and by Company.

For buried services requiring to be crossed by boring, the relevant provisions section 16 of this specification, shall apply.

However, prior to crossing any existing buried facilities, Contractor shall obtain a No Objection Certificate (NOC) from the Company proposing the appropriate crossing requirements specified below.

### III.10.4.2 Crossing of ROW, Service access Roads

ROW / Service Access Roads of the new Pipelines or any new facilities are not allowed to cross above the existing buried MOLs (Main Oil Lines), Oil Transferlines and Gas Trunklines due to the criticality of these facilities and to avoid applying inconsiderable loads. It is Contractor responsibility to divert, as part of his scope of work, the new pipeline / facility ROW to the nearest official road crossings available on the existing pipelines even if they are away from the crossing location. In some rare cases where the official road crossings are very far from the new ROW crossing (> 2.0km), Contractor shall apply the crossing protection as per the below Criteria 3.
ROW / service access road of the new pipeline can cross the existing buried pipelines only subject to compliance to any of the following criterion:

Criteria 1:
Contractor shall carry out the road crossing calculations for existing pipelines at the proposed crossing location to satisfy the requirements of API RP 1102, based on the design parameters and actual wall thickness and material grade of the existing flowlines at that section, considering a minimum design factor of 0.6.

Criteria 2:
In case the existing pipeline calculations fail to meet the above requirement, Contractor shall seek Company approval to cut the flowlines section at crossing and replace it with the higher wall thickness pipe of same material grade, meeting API RP 1102 requirements, considering a minimum design factor of 0.6.

Criteria 3:
In case it is not feasible to replace the pipeline section at crossing due to any operational reasons, Contractor shall provide protection to the existing flowlines by using suitable concrete culverts above the existing pipeline. Culvert design shall be approved by the Company.

Criteria 4:
In case Contractor fails to meet any of the above criterion, vehicular movement for pipeline construction, inspection and service access of new pipeline shall only use the nearest assigned official crossing locations on existing pipeline corridors. In such cases, access barriers shall be installed to block new pipeline access on top of existing pipelines to avoid the vehicular movement at these intersections.

### III.10.4.3 Crossing of deep embedded pipelines

In case of very deep existing buried pipelines (> 3.0m from the ground level not from berm height), new pipeline could cross above the existing pipelines provided that the minimum depth of cover to the natural grade and minimum clearance required to the existing deeper pipelines are met. This is not applicable for the new ROW crossing existing pipelines which shall follow the requirements of clause 16.4.2, other safety requirements, manual excavation, identification slabs, pipeline markers and CP junctions shall be applied as per this specification.

#### III.10.4.4 Crossing of Surface laid flowlines

The new buried pipeline shall cross below the existing surface laid flowlines with a minimum clearance of 1500 mm.

#### III.10.4.5 Crossing of Corridors

Whenever new pipeline crosses the assigned Pipeline Corridor of min.100m width, pipeline shall be buried across the entire Pipeline Corridor, with depth of cover requirements and minimum clearance requirement specified above.

### III.10.5 Other Crossings

#### III.10.5.1 Buried Pipelines

In addition to the existing crossings, the pipeline shall be installed at the following locations as per standard requirements for road / vehicle and rig crossings, as defined in this Specification and as per Typical Construction drawings:

- Locations where the new pipeline crosses existing pipelines.
- Locations where the pipeline crosses planned roads.
- Locations where new pipelines crossing existing ROW.
- Overhead Lines crossings.

#### III.10.5.2 Aboveground Pipelines

The pipeline/flowline shall be installed underground at the following locations as per standard requirements for road/ vehicle and rig crossings, as defined in this Specification and as per Typical Crossings drawings

- Right of Ways of existing pipelines
- Locations where the new pipeline crosses the existing pipelines
- Locations where the new pipeline crosses planned roads / pipelines and utilities corridor.
- Existing or planned overhead lines crossings along with its right of way.
- Existing surface laid flowlines and their access tracks.
- CICPA fences shall be crossed using thrust boring at 2m depth.
- For Pipelines & Buried cables & utilities the minimum clearance shall be 1000mm between top of new pipelines and bottom of existing pipeline, cable & utilities.

New aboveground flowlines and overhead Lines crossings the existing flowline, pipeline, ROW / service access road shall comply with one of the following criterion:

Criteria 1:
Contractor shall seek Company approval to cut the pipeline/flowline section at crossing and replace it with the higher wall thickness pipe of same material grade, complying with API RP 1102 requirements, considering a minimum design factor of 0.6.

Criteria 2:
In case it is not feasible to replace the pipeline/flowline section at crossing due to any operational reasons, Contractor shall provide protection to the existing pipeline/flowline by using suitable concrete culverts above the existing pipeline/flowline. Culvert design shall be approved by the Company.

Criteria 3:
In case Contractor fails to meet any of the above criterion, Contractor's vehicular movement for construction, inspection and service access of new flowlines and OHL shall only use the nearest assigned official crossing locations on existing pipeline corridors. In such cases, access barriers (Jersey barrier) shall be installed to block the new access on top of existing pipelines/flowlines to avoid the vehicular movement at these intersections and Contractor shall prepare the ROW diversion to the official crossing as part of new pipeline construction SOW.

### III.10.6 Existing Culverts

Existing concrete culverts, if any, available at road crossing shall be investigated by the Contractor during detailed design.

Contractor shall first expose the culvert, clean it out and confirm suitability for installation of the new pipeline. Following confirmation of suitability and approval by Company, Contractor shall incorporate the existing culverts into the design and optimize the pipeline routing accordingly.

Contractor shall submit a proposed method statement to the Company, including details on installation of the pipeline provision of cathodic protection and any other requirement necessary to utilize the culvert. Following Company review and/ or approval, Contractor shall implement all such requirements without any cost implication to the Company.

Crossing of existing pipeline installed on gatched embankments shall be implemented as per typical construction drawings below existing embankments.

## III.11 TIE-INS

Pipeline Tie-Ins shall be carried out in accordance with Pipeline Tie-in Schedule / Details.

### III.11.1 Tie-in to New Pipelines

A tie-in weld shall be a weld which connects one restrained string of pipeline to another restrained string, or to the pipeline under construction.
Field cuts shall be true, square and accurate with no ‘springing’ required to make up the joints.
A tie-in weld shall not commence without prior approval from the Company.
A string shall be considered restrained if sufficient accumulative friction forces are provided by ‘tail’ (a length of at least 400M of buried pipeline, or of 800 M on wooden skids or on sand).

### III.11.2 Method for Tie-In of Pipelines

When a sufficient number of strings have been completed, the first string may be placed in the trench and spot backfilled when the pipe temperature is within the tie-in temperature range. The tie-in temperature shall be as specified in respective project design basis. The subsequent strings shall be connected to the previous string by tie-in welds. The portion of pipeline between trench and bank shall be supported by side booms holding the line in a gentle “S” curve. There shall be at least 200 M of pipe on the bank to keep the “S” curve in sufficient tension to restrain the pipe in the trench. Alternatively, the tie-in weld may be made in the trench with the tail resting in the trench.

### III.11.3 Tie-In of Pipelines in Trench

Where pipeline sections are to be tied-in following lowering-in and backfilling operations, the length of pipeline left open shall be kept to a minimum.
Contractor shall carry out all tie-in operations in accordance with the specifications referenced herein.
Tie-in welds connecting restrained pipeline sections shall be carried out at the minimum pipe temperature. Where necessary to avoid straining the pipe, sufficient restrained sections of pipe shall be uncovered to allow slack loops to be held during alignment of the butt and welding of the final tie-in joint. Under no circumstances shall the pipeline be left in tension after the tie-in.
Bell holes excavated to facilitate access shall provide adequate clearance for welding, weld inspection and field joint coating activities. The overlap of pipe strings at tie-ins shall be at least 2.5 m. All tie-in welds shall be subject to 100 percent radiography and ultrasonic examination.

Tie-ins connecting one or more unrestrained pipeline sections shall be done at the highest ambient temperature to minimise expansion loads. Contractor shall record the ambient temperature at the time of tie-in welding and shall report the same to Company.

### III.11.4 Tie-in of Aboveground WI Flowlines

The new WI flowlines tie-in with the existing WI header shall be elevated at the tie-in point location. The WI flowline shall also be provided with expansion offsets to limit the stress transfer from new flowline to existing Header.

### III.11.5 Pipe Pups

In general welding of the pup-pieces shall be avoided unless required for other reasons.

When pipe pups are required for the tie-in, the minimum length that may be used shall be 1.5m. Under no circumstances shall two or more such pups be welded together. All pipe pups measuring 1.5m and over shall be carried forward and used in the pipeline where required. Pipe pups shorter than 1.5m shall be collected by the Contractor and delivered, as directed by the Company, to the pipe stock sites.

Tie-ins may be completed using two or more pipe pups providing they each have minimum length of 1.5 m and are separated by a complete random length of pipe. Under no circumstances shall more than three (3) welds be permitted on an eight (8) meter length of pipeline.

A six metre (6m) pup piece shall be installed in the pipeline at one kilometre separation at each kilometre marker post.

### III.11.6 Fittings and Equipment

When welding special items such as fittings and equipment, with different wall thicknesses, Contractor shall transition the pipe according to the relevant codes, standards and specifications listed and applicable welding procedure.

### III.11.7 Pressure Tested Sections

For Tie-in of a section of Pipeline that has already been pressure tested, Contractor shall ensure adjacent section overlap so that only one tie-in weld is required. The tie-in of pressure tested pipeline sections, where an overlap is not available, shall be carried out using a single length of pre-tested pipe. Contractor shall ensure that during construction sufficient quantities of pre-tested pipe are readily available.

### III.11.8 Tie-In to Existing Flow Lines

Work on the tie-in to existing flowlines shall not commence until a procedure for the execution of the tie-ins has been approved by Company and a permit to commence tie-ins has been issued by the Company.

All existing pipelines will not necessarily be free of hydrocarbons when handed over to the Contractor. The procedure for tie-ins shall therefore address:

- Safety
- Venting and depressurising
- Containment of hydrocarbons during swabbing
- Cold cutting
- Isolation of weld area (by bladders or plugs) in preparation for hot works.
- Alignment
- Weld preparations
- Weld procedures and qualification test
- NDE and testing
- Re-commissioning

- Site clean up
- All tie-in welds shall be radiographed in accordance with the relevant project specifications.

### III.11.9 Miscellaneous

It shall be ensured that during the welding operation the material in the region of the weld pool has sufficient strength to contain safely the internal pressure and avoid a blow-out. The risk of blow-out is dependent upon a complex interaction of welding conditions, pipe material, pipe thickness, pipe temperature and hoop stress.

Hot tapping welding shall not be performed on lined, clad or internally coated pipe.

Responsibilities for dedicated activities required to assure personnel and plant safety, integrity of the work performed, etc., will normally rest with the typical functions indicated below. It is however important that overall responsibility for the work is clearly assigned to a single individual.

## III.12 WELDING

Pipeline welding shall be carried out in accordance with ADCO Specification for Welding of Pipelines and Related Facilities, Document No. 30-99-00-0041 (AON).

Pipelines to be installed in the same trench shall be welded at the same time, but with the welding crews staggered along the string.

A pipe pup of length 6m shall be welded into the pipelines at every kilometre post, for the location and identification of defects during intelligent pig surveys.

Contractor shall ensure the pipe is fully supported during positional welding operations to prevent any movement and subsequent weld cracking. Earthing clamps shall be connected to the bevel face and shall not rest on the parent metal surface adjacent to the weld preparation area. The clamps used shall be subject to Company approval.

All welded joints shall be subject to 100 % radiographic inspection.

## III.13 FABRICATION OF ASSEMBLIES

Fabrication of valves, fitting and other components into assemblies shall be governed by all pertinent clauses of this specification as well as the following requirements.

### III.13.1 Fabrication and Testing

Fabricated assembly of valve sections, test equipment and other components may be performed at fabrication shop or yards away from the final location of the assembly. All material descriptions/ traceability certificates, weld numbers, welder identification numbers and other details required for the pipe book shall be inserted into the Pipe Book for all fabrications.

All welds shall be tested and assessed in accordance with the NDT Procedure at or adjacent to the final location of the assembly.

Hydrostatic testing of fabricated assemblies shall also be performed at or adjacent to the final location.

Manufacturers' recommendation shall be followed when welding fittings and equipment into the pipelines.

Alignment of prefabricated assemblies shall be performed with a minimum use of mechanical force.

### III.13.2 Small Diameter Ancillary Connections to Pipeline

All small diameter connections such as vents, drains, balance valves on the pipeline and pig launcher/ receiver traps shall be welded to the pipeline with weldolets/ and provided with weld neck flanges.

### III.13.3 Protection of the prefabricated assemblies

Upon welded into fabricated assemblies, all valves supplied without operators shall have a covering placed over the open end to prevent ingress of sand or debris.

## III.14 FIELD JOINT COATING

Field Joint Coating shall be carried out in accordance with ADCO Specification for external pipeline coatings, Document No. 30-99-37-0017 (AON).

### III.14.1 Care in Handling Coated Pipe

Coated line pipe shall not be handled or moved by means of cables or chains, or levered using skids or bars, or dragged along the ground. The line pipe shall only be lifted, moved and laid using suitable lifting equipment of non-abrasive material having adequate width to prevent damage to the pipeline coating. Care shall also be exercised when removing slings from around the coated line pipe following lowering-in operations into the trench. Lowering-in using a standard pipe cradle shall be permitted providing the Contractor demonstrates the pipe coating is not damaged. Under no circumstances shall the pipeline be slung around the completed field joint coating. Handling of coated pipe shall be in accordance with Specification for Handling, Transportation and stockpiling that is to be developed by the Contractor.

### III.14.2 Holiday detection and Damaged Coating Repair

Before lowering-in operations commence, the integrity of the completed pipeline coating system shall be checked using a calibrated full-circle holiday detector at 25KV. This shall ensure a 100 percent, holiday-free pipeline (factory and field joint) coating system. Contractor shall repair all damages to the satisfaction of the Company. All points on the pipeline where the coating had been in contact with either skids or lifting equipment during handling shall be carefully inspected for damage, denting or other defects and any defects shall be completely repaired. Should it be necessary, after checking, to place the pipeline back onto supports on the bottom of the trench, the supports shall be padded in such a way as to prevent damage to the coating. Before the last operation, a check must be made of the coating at points of contact with the supports.

The Contractor shall submit detailed procedures for coating repairs. The procedures shall contain as a minimum:

- Repair of surface defects
- Repair of pinholes, scratches and small defects
- Removal of rejected coating and cleaning the pipe to the required standard for recoating
- Testing to prove the effectiveness of repairs

All pipes that have been repaired shall be re-examined in accordance with the quality control procedure. A record shall be kept of all the repaired pipes including the repair and re-test details.

## III.15 LOWERING-IN OF PIPE

Lowering-in shall be carried out at the same time for all strings being installed in the same trench.

When it becomes apparent the pipeline is being laid under tension as a result, for example, of incorrect positioning of bends (either horizontal or vertical), the trench shall be modified to match the pipeline configuration. In exceptional circumstances, following approval from the Company, a new assembly shall be fabricated, at no cost to the Company, to fit the excavation and laying bed.

Pipeline laying operations shall be carried out under safe conditions to avoid unacceptable induced stresses and temporary deformation that may cause consequent damage to the pipeline coating. Where the Right-Of-Way is restricted to less than the minimum necessary for the movement of mechanical equipment, the laying operations shall be carried out using other suitable means.

The line pipe shall be placed smoothly onto the trench bottom or excavation floor whilst preventing any jerking, falling and impact movements that may induce stresses. Contractor shall ensure that the deformation caused during lifting the pipeline from the skid supports does not exceed the minimum allowable radius of elastic curvature. This will ensure the stresses on the pipeline and coating remain within safe limits and over stressing of the pipe and subsequent permanent deformation do not occur.

The suspended section of the pipeline between the trench bottom and skids shall be supported using sufficient side-booms to hold the pipeline in a gentle S-curve whilst maintaining the minimum elastic bend radius. The number of side-booms shall be adequate, not less than three, to allow safe and efficient pipe laying operations to be carried out and shall be approved by the Company.

The entire length of available pipeline section shall be laid without interruption. Where water is present, no laying shall be permitted until the trench has been completely drained allowing the necessary time to carry out the visual inspection of the trench bottom and subsequent bed on which the pipe is to be laid. If draining the water is not possible, Contractor shall propose alternate method of installation to be approved by the Company.

Contractor shall take precautions immediately following lowering-in to prevent movement of the pipe in the trench.

### III.15.1 Method and Time of Lowering-In Pipe

Lowering-in of the pipeline shall commence following removal from the trench bottom of all pipe off-cuts, skid supports, stones, debris, stakes, rock projections and any other rigid materials which, if left underneath the pipe, could lead to perforation or tearing of the pipeline coating. Sand padding shall be placed in the trench bottom prior to the lowering-in operation in accordance with this specification.

The lowering-in operation shall follow as soon as possible, after completion of the field joint coating of all pipelines for the same trench and clearing of the trench bottom.

The pipelines shall be installed in the sequence as shown on the drawings and Contractor shall ensure that the spacing requirements at the bottom of a common trench between pipelines and fibre optic cable are maintained.

Before lowering-in, short completed sections of the pipeline shall be cleaned with Company approved method in order to remove all debris and foreign matter from the inside of pipe sections.

### III.15.2 Lowering-In of Slack Loops

Following completion of sand padding, slack loops shall be lowered-in as necessary, to hold the bends in the correct position. The lowering-in of slack loops shall be carried out only when approved by the Company and the pipeline has fully contracted.

### III.15.3 Timing of Lowering-In of Pipe

Contractor shall consider the timing of the lowering-in operation, the quantity of pipe available for lowering-in and the required backfilling operations when confronted with unstable trench conditions and/ or inclement weather. Company may stop the lowering-in operation if it appears the required backfilling operation cannot be kept up.

All measurements and survey data required for completion of the "As-Built" drawings shall be taken prior to backfilling.

## III.16 BACKFILLING

Backfilling operations shall not commence until all pipelines, fibre optic cables and any associated equipment have been positioned correctly in the trench to provide the required cover and alignment in accordance with the approved construction drawings. Prior to backfilling, the Company shall be informed and the installed pipeline

made available for final inspection. Backfilling shall not commence without Company approval. Company shall reserve the right to request removal of backfill to inspect the installed pipeline and all costs associated with this Work and the subsequent replacement of backfill material shall be the Contractor's responsibility. Subject to compliance with this Specification, the backfilling operation shall follow as closely as practical to the lowering-in of the pipelines and fibre optic cable. Pipelines shall be covered not later than the day following that during which it was lowered. This shall ensure the pipeline is secured into position in the trench and will prevent damage to the pipeline coating from exposure to temperature and weather. Contractor shall protect the backfill material against washouts, etc., until completion and final Company acceptance of the Work. In case of more than 1 day gap between lowering in and backfilling pipeline, Company may ask Contractor to carry out holiday detection test for the pipeline section at Contractor cost.

Backfilling shall be done at the highest ambient temperature.

### III.16.1 Selected Backfill Materials and Padding

Hard materials such as rock, gravel, etc. shall not be used as padding directly onto the pipe. When such materials are encountered during trench excavation, Company shall decide and authorise in writing the extent of trench padding required. Contractor shall provide the necessary padding as required.

In such areas and other areas designated by the Company, sufficient sand shall be placed under, around and over the pipe as to form protective padding extending to a height of 200 mm above the pipe. The padding shall be installed using a method approved by the Company and the Contractor shall ensure no sharp rocks or hard objects are present in the backfill material.

Standard backfill material for placing on top of the sand padding shall not contain gravel or rock over 75 mm in diameter.

Loose rock, wherever encountered, may be returned to the trench, subject to Company approval, following placing of selected backfill material over the top of the pipe.

### III.16.2 Special Treatment of Trench Backfill

Where the trench has been excavated through road/ tracks, etc., all backfill shall be thoroughly compacted to 95 percent Proctor Density. In certain cases, Company may require special compaction methods to be used during backfilling of the trench to avoid settlement. The backfill surface shall be stabilised with crushed rock or other suitable material as approved by relevant authorities.

In all such cases, Contractor shall comply with the requirements of the relevant Authorities as part of his scope of work for all operations up to reinstatement.

Underground drainage that has been interrupted by trenching operations shall be carefully reinstated and any damaged sections replaced. Backfilling shall be carried out without the use of mechanical equipment in locations where, in the opinion of the Company, damage may occur to any existing service or structure in the vicinity.

### III.16.3 Furrows, Terraces, Water Breakers

Where placed backfill may be washed out of the trench bottom, Contractor shall provide terraces or effective water breakers across the trench to divert the flow of water away from the trench into existing drainage channels. This requirement is typical when backfilling trenches on terrain sloping at an angle of 10 percent or more and on the banks of water courses. Under no circumstances shall the surface water be diverted into channels other than those existing prior to excavation of the pipeline.

### III.16.4 Position of Backfill

Following completion of the trench backfilling operations, the ROW in the vicinity of road track crossings shall be re-graded to the original contours necessary to assure the safety of the pipeline and the continuing passage

of traffic. Completion of trench backfilling operations at other locations along the pipeline can be carried out using conventional mounding over the pipeline. The mounding shall be suitably compacted and trimmed.

Final compaction of the backfill material at the various locations shall be accomplished by tamping or by running a rubber tyre compacting device, approved by the Company, over the top of the backfill or as otherwise directed by the Company. Temporary markers shall be located on top of pipeline after backfilling to ensure that external berm to be mounted exactly on top of the buried pipeline.

At the end of each work shift, partial backfilling (shading) shall not be more than 1000 metres behind the head end of lowered-in pipe, which has been inspected and approved for backfilling.

### III.16.5 Crown/ Berm Over Trench

For all the pipelines, the backfilled trench shall be provided with a berm formation as detailed on the Drawings. The material for this berm shall be of material as detailed in the typical drawings and approved by Company. Contractor shall ensure the berm is centred over the trench using the temporary markers for guidance. The temporary markers shall only be removed following commencement of berming operations.

The drainage system design shall comprise of, but not limiting to, concrete duct, culverts etc.

In case the pipeline is running in an existing pipeline corridor, the existing drainage system design shall be adopted as a minimum.

Suitable provisions of drainage system for the pipeline corridor shall be made at low points so as not to disturb the natural flow of rainwater thus avoiding any impact on the ecology. The details of such provisions shall be approved by Company.

### III.16.6 Stabilization of Backfill

Contractor shall stabilise the backfill material to provide a consolidated cover over the pipeline.

The backfill material shall be stabilised using a 500mm layer of gatch material placed on top of the pipeline. Further requirements for stabilising the backfill and ROW are detailed on the AFC ROW and Trench Construction drawings in Sand Dune Areas.

All work associated with the stabilisation of backfill material, including the supply of stabilising material, shall be carried out by the Contractor.

### III.16.7 Construction in Sand Dune Areas

Construction of pipelines in sand dune areas shall be primarily based on the graded profile resulting from upheaval buckling analysis recommendations. Pipeline profile shall be maintained as per the allowable over bend angle/ lateral angle per 12m of pipeline in the sand dune areas. Minimum elastic bend radius shall be followed for over bends and horizontal bends in case these bend angles are less than the allowable over bend angle. Necessary cutting and filling shall be carried out to achieve the above said requirements.

Further, upheaval verification shall be carried out after pipelines installation. After lowering of the pipeline and before backfilling, Contractor shall measure the top of pipe elevation every 100m in the flat areas (in both sand dunes and sabkha areas), whereas it shall be measured at every 10m distances for the highly elevated dunes/ profile portions that have the tendency for "vertical" upheaval buckling.

The data shall be provided to the Contractor stress engineer to check/ confirm the upheaval buckling study results post installations and identify the required damping loads and their locations along all pipelines routes.

### III.16.8 Berming and Backfilling of Pipeline in Sabkha Areas

The type of Construction in Sabkha areas shall be as detailed in the Typical Drawings.

The pipe laying areas shall be thoroughly cleaned or padded with sand to ensure that there are no hard materials which may damage the pipeline coating.

The procedure for lowering-in shall be the same as specified for positioning the pipeline into a trench.

After Inspection and lowering of the pipeline in the presence of Company, the pipeline shall be sand padded and bunded.

The material used for backfilling shall be gatch, earth or any other suitable material, which can be consolidated by compaction. The backfilled material shall be wetted with water and applied over the pipeline. The compaction of the backfill shall be such as not to damage the pipeline or pipeline coating. The Contractor shall mobilise the necessary equipment for compaction. The method of compaction shall be approved by Company commencing this section of the works.

The pipeline backfill shall form a berm centered over the pipeline. The minimum pipeline berm cover (soil embankment) shall be 1.0 metre as measured from the top of the pipeline.

The final 500 mm layer of the 1.0 metre high berm shall be stabilised using a 500mm layer of gatch material. The stabilised layer shall be constructed by wetting the gatch material with water to its optimum moisture contents and placing it on the Sabkha backfill material, then compacting with the wet gatch as described above. The design of any berm shall minimize erosion of the backfill. In general the pipeline berm shall be constructed using the methods described in this Specification and Typical details of Pipeline Construction in Sabkha Areas. For upheaval buckling post installation survey, refer to section 22.7. However, for lateral buckling at change of directions in Sabkha flat areas or at low level areas in between the high elevated sand dunes, the requirement of reinforcement of berm to avoid lateral buckling shall be in accordance with typical drawing no. 30-99-22-0006 (AON), sheet 14.

The Gatch Material shall be the same as described in this specification.

## III.17 MARKERS

Contractor shall provide pipeline warning signs at specific locations along the pipeline route. The warning signs shall be in accordance with the approved drawings and installed at one kilometre intervals along the pipeline route and starting from zero chainage at the upstream facility fence line. Where more than one pipeline is installed in a common trench the chainage should follow the reference line on the alignment sheet.

In populated areas and areas where the pipeline is laid very close to the existing pipelines, additional warning signs shall be installed at maximum 250 m intervals. At station approach, collective marker signs combine many pipelines tags shall be designed and constructed wherever bundles of pipelines are routed toward the station as well as at the crossings location around the stations. Warning signs shall also be installed at changes in horizontal direction, each side of highway crossings, track and minor road crossings, foreign pipeline valve stations and utility crossings and at all electrical test lead locations.

Additional warning signs shall also be installed at locations specified in the Alignment Sheets.

Pipeline warning signs shall identify the existence of a buried pipeline and display the Company name, emergency telephone number and the cumulative distance in kilometres. Contractor shall submit design of pipeline warning signs for Company's approval prior to fabrication. Fabrication details shall be as per drawings approved by Company TEMPORARY PIPELINE MARKERS

Immediately following completion of backfilling operations, Contractor shall install temporary wooden pipeline markers directly above the trench centreline. These temporary markers shall be spaced at intervals not exceeding 50 m and shall be used to determine the final berm position.

## III.18 CATHODIC PROTECTION (CP) INITIAL REQUIREMENTS

### III.18.1 General

A temporary cathodic protection system shall be installed as backfilling operations proceed in order to protect the pipeline till the permanent cathodic protection system is commissioned.

Installation sequences of the temporary and permanent CP components shall be arranged and agreed with the Company prior to commencement of the Works. Company shall witness the installation of all system components.

The temporary CP system shall be connected and operating upon lowering in the pipeline.

### III.18.2 Baseline CP Survey

Following completion of pipeline laying and backfilling operations and following commissioning of the Cathodic Protection system, Direct Current Voltage Grid (DCVG) survey and Close Interval Potential Survey (CIPS) shall be conducted along the entire pipeline, as specified in the ADCO Engineering Specification 30-99-37-0004 (AON) and project specification for cathodic protection system philosophy for buried pipelines. DCVG survey shall detect any coating failure after the backfilling and mechanical completion of the pipeline. CPLS survey shall measure the potential between the soil and steel pipe.

The survey shall be carried out by the Contractor at his own cost, and shall locate defects, if any, in the pipeline coating. The Contractor shall, where necessary, uncover the pipeline and make necessary repairs to the pipeline coating to the satisfaction of the Company. All costs associated with such repairs shall be the Contractor's responsibility.

## III.19 HIGH VOLTAGE SYSTEMS INFLUENCES DURING CONSTRUCTION

### III.19.1 General

Pipelines constructed in the vicinity of high voltage power lines may be electrically influenced by the power lines. High voltage lines are defined as power lines which are rated at more than 11 kV. Stray voltages resulting from the proximity of the high voltage lines may at times be so high as to pose a danger to personnel working on the pipeline. It is imperative, therefore, that the instructions detailed below shall be strictly observed.

Contractor shall follow the latest edition of the following standards during design and construction of the pipelines.

National Association Of Corrosion Engineers Standard: NACE SP0177 “Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems”

It is a pre-requisite that all personnel working on the pipeline in the vicinity of the high voltage system be given clear instructions on the precautions to be taken.

Vehicles and equipment shall be earth-connected. This may be achieved by attaching an uninsulated length of cable or chain to the underside of the vehicle which drags or at least touches the ground at all times.

Special precautions shall be taken for plant and equipment operating within a 50 m limit from the centre of the high voltage systems to prevent unauthorised entry inside this limit. Entry shall only be permitted to personnel,

plant and equipment complying with Company's procedures for working in the vicinity of overhead high voltage power lines.
During thunderstorms or when discharges are observed from the power line insulators all personnel are to leave the area in close proximity to the high voltage lines and the pipeline adjacent to this area.

To prevent the build-up of electrical voltage in non-buried pipeline sections rising to dangerous levels, the pipeline shall be welded in section lengths not exceeding the calculated length at which the maximum permitted voltage may be induced. This length may be calculated using an approved method of calculation.

Before a pipeline section is lifted and lowered into the trench, the structure's earth electrodes as indicated on the drawings or determined by calculation, must have been installed and connected to both the pipeline section already buried and to the section which is about to be lowered-in. The electrical connections which serve the purpose of preventing the build-up dangerous voltages must have a minimum cross sectional area of 35 mm2. These connections must not be removed until after the permanent, safety earth connections have been installed and connected to the entire, uninterrupted pipeline. The earthing arrangement shall be subject to Company's approval.

Personnel working inside the area in close proximity to the high voltage lines must wear electrically insulating foot-wear (e.g. rubber soled boots) and wear untorn insulating rubber or plastic gloves.

### III.19.2 Additional Measures for Work

In addition to the precautions detailed in Section 25.1 of this Specification, all Work carried out within the 50metre limit from the centre of high voltage systems shall also comply with the following regulations:
No Work shall commence until agreement concerning the implementation of the safety measures, specified in this Section, has been reached with the Authorities who operate and control the high-voltage system.
Procedures and safe working systems must be adopted to prevent excavating and lifting machinery from approaching high voltage power lines to within the distances as specified below.

These minimum distances are dependent on the system voltage. For individual connections, the minimum encroachment distance must be:

| | |
|---|---|
| 0-50 kV: | 3 m |
| 40 - 200 kV: | 5 m |
| 200 - 380 kV: | 8 m |

The precautions taken shall be as follows:
Selection of specialist equipment shall be, limiting or blocking movement, in certain directions and limiting the operational area. These relatively simple but effective precautions can be introduced by fitting of temporary mechanical stops to machinery therefore making it impossible for any work to carry out within the accepted minimum distance from the high voltage power lines.

In cases where the precautions recommended in paragraph 1 above are not feasible, installation of clearly visible barriers shall be carried out. Ground areas shall be marked using lines of drums painted bright red and white and height restrictions shall be marked using red and white flags suspended below the maximum allowable working height. Clear signs shall accompany the barriers stating "No Passage Beyond This Point" preventing any Work being carried out inside the danger area.
In addition to the above precautions, Contractor shall provide a Safety Representative to be in attendance at all times.

## III.20 FINAL CLEAN-UP OF THE CONSTRUCTION RIGHT-OF-WAY (ROW)

### III.20.1 General

Following completion of backfilling operations, the ROW and any other areas used in connection with construction of the pipeline shall be reinstated to their original condition. All reinstatement shall be subject to Company approval and shall be carried out to the satisfaction of the relevant Government Authority.

All surplus excavated materials, defective construction materials, pipeline debris, refuse and unsuitable spoil materials shall be collected and disposed of by the Contractor to an approved site.

Loose rock scattered over the ROW or adjacent property shall be graded and transported by the Contractor to an approved disposal site. The ROW shall be graded smooth and all surface soils shall be carefully replaced to the approval of Company.

The topsoil removed shall be reinstated to its original location and the land restored to its original condition.

Where the roads have been graded, trenched or otherwise disturbed, the roads shall be restored to their original contour and conditions to the satisfaction of the relevant authorities.

Terraces, drainage and gutters, whether earth or stone, which have been destroyed or damaged by construction operations shall be reinstated to their original condition.

All fences cut or damaged, shall be repaired by installation of new fence sections equal to or better than the sections cut or damaged. All temporary gates shall be removed and replaced by new fence sections to the satisfaction of the Company and the Owner.

### III.20.2 Progress of Intermediate and Final Clean-Up

Final clean-up operations shall not be left incomplete for more than one kilometre behind the completed backfilling operations, except with prior approval from the Company. Company reserves the right to shut down, without any compensation, Contractor's pipeline construction operations, with the exception of the backfilling and clean-up operations, whenever the final clean-up is left incomplete for more than 1 kilometre. Special attention shall be given to the removal of discarded electrodes in the ROW and pipeline trench. All discarded electrodes shall be removed immediately following welding operations, on a daily basis.

Final grading of the ROW shall be smooth enough to provide access for all maintenance vehicles with minimum 6 meters width.

Where a maintenance road has been constructed, it shall be graded and compacted ready for handover.

## III.21 ENCROACHMENTS AND WORKING NEAR OTHER UTILITIES

In locations where the pipeline has to be laid in the body of a road, or any other location under the jurisdiction of Government and/ or Public Bodies, the Contractor shall perform such work without extra compensation in accordance with the requirements of the relevant Authorities. Where the Contractor has to resort to hand excavation, well-pointing or other means of water removal, erection of sheet piling or any other special construction method in these locations, no extra compensation shall be admissible. It shall be the Contractor's responsibility to contact the Authorities concerned in order to become familiar with and comply with their requirements.

In locations where the pipeline has to be laid parallel to an existing pipeline and/ or other utility in the ROW, the Contractor shall perform the work to the satisfaction of the Owner/ Authority of the existing pipelines/ utilities. The Contractor shall, at these locations, perform work in such a way that even under the worst weather and flooding conditions, the existing pipelines/ utilities shall remain stable at all times and shall neither become undermined, nor have the tendency to slide towards the trench. All works carried out in the vicinity of existing pipelines/ utilities and their associated installations shall comply with safety requirements as set out in Section 2 Codes and Standards of this Specification, and the relevant Company Standards.

In areas where existing buried services such as pipelines, conduit cables or other underground structures are to be crossed, Contractor shall confirm their position using electronic pipe and cable locator of high resolution. Contractor shall hand excavate to expose all buried services prior to the operation of any mechanical equipment within ten (10) meters of the located services. These operations shall only be performed after obtaining prior approval from the Company and the relevant work permits.

In no instance shall mechanical equipment be permitted within 5 meters of any buried service or structure unless written approval from Company and OWNER is obtained. Contractor shall be liable for any damage occurring to, or resulting from, damage to other pipelines and underground structures/ utilities.

## III.22 LIMITATIONS OF WORK SPREAD

Contractor shall schedule all construction activities to maintain the following limitations for working spread:

- Between stringing and main line welding: 3 km max
- Between final clean-up & backfilling 1 km max
- Between trenching and backfilling: 4 km max
- The maximum cumulative length of open trench shall not exceed 5 km.

## III.23 HYDROSTATIC TEST PROCEDURE

Upon completion of pipeline installation and backfilling, the pipeline shall be cleaned, gauged and tested in accordance with the Specification for Hydrostatic Pressure Testing of New Pipelines Document No. 31-40-40-38A (AON). The hydrotest water shall be fully treated with scavenger, biocide and inhibitor.

The hydrostatic test water shall be disposed of in such a manner as to eliminate any environmental impact to the surrounding areas. The location, method and water disposal scheme shall meet all the requirements of the local Statutory Authorities and shall be approved by Company.

The treated hydrotest water shall not be disposed in the desert unless the water meets the requirements of "ADNOC Limits for Effluents Discharged into the Desert" as per ADNOC Group Environmental Protection and Occupational Health Management Procedures. Contractor may consider construction and use of evaporation pits for the disposal of test water and will include the same in his quoted price.

Contractor shall be responsible for obtaining all permits and approvals from the local Statutory Authorities prior to commencement of water disposal and all clearance certificates following completion of the water disposal activities.

All Works associated with these activities shall be carried as a part of Contractor scope of work.

## III.24 PIPELINE PRE-COMMISSIONING AND COMMISSIONING

After successful completion of hydrostatic testing of pipeline, and acceptance of test results by Company, the Contractor shall carry out pre-commissioning in accordance with the ADCO Specification for Pre-commissioning of Pipelines Doc. No.30-99-23-0114 (AON).

Contractor shall be assisting the Company in commissioning activities.

Contractor shall provide all materials required for pipeline commissioning.

## III.25 PRESERVATION OF PIPELINE

Company may, at its option, require Contractor to defer commissioning activities and preserve the pipeline for a duration not exceeding six months. In this case, Contractor shall de-pressurise the pipeline and shall hold the pipeline to an internal pressure of 1.5 bar g. Contractor shall add sufficient quantities of corrosion inhibitors in the water in order to prevent any corrosion in the steel pipeline during the specified preservation period. Contractor shall submit to Company details of the chemicals proposed to be added along with calculation for the required quantities to prevent pipeline corrosion.

In case of a new pipeline need to be preserved upon Company request, the pipeline shall be filled with dry nitrogen at 1.5 barg in accordance with Company Specification for Pre-commissioning of Pipelines Doc. No.30-99-23-0114 (AON).

Prior to commissioning, liquid hydrocarbon pipelines shall require to be conditioned with the batch of corrosion inhibitor, as described in Specification for Pre-commissioning of Pipelines Doc. No.30-99-23-0114 (AON).
Preservation Procedure shall be followed when preservation is required for long lay-up of complete pipeline system.

## III.26 CONSTRUCTION OF ABOVE GROUND INSTALLATIONS (AGI'S)

### III.26.1 General

In addition to the pipelines, the Contractor is also responsible for construction of the associated AGI's such as the launching and receiving pig trap installations, pipeline sectionalising valve stations, pipeline tie-ins and any other facilities necessary to ensure the pipeline systems are complete and ready for operation.

The work required to complete the installations shall, where applicable, include all site surveys, site preparation, filling, grading, concrete pits, fencing, foundations, main line valves, by-pass valves, pipework, cold vent facilities, pipe supports, anchor blocks if required, instruments, mechanical facilities, civil work, painting and coating; installation of all electrical equipment, motors, cables, conduit, wiring and fixtures and final hook-up; installation of all instruments, piping, valves and fittings; mounting of all instruments and making all piping, electrical and instrumentation connections.

Contractor shall ensure that the piping assemblies are not under strain prior to final bolting or welding. Contractor shall also ensure that all equipment and piping is thoroughly swabbed clean of dust, debris, welding-spatter, scale, or any potentially detachable matter prior to final tie-in or closure bolting.

Necessary platforms shall be provided for all equipment, valves and instruments for proper access for operation and maintenance. Crossovers shall be provided for proper movement in accessing the equipment / skids.

On completion of the Work, all elements for each installation, shall be inspected and tested for complete and correct functional operation in the presence of, and to the satisfaction of Company. All Work shall be carried out strictly in accordance with the appropriate Codes and Standards, Project Specifications, approved drawings, and this Specification.

### III.26.2 Painting of Above Ground (A/G) Work

All above ground carbon steel surfaces such as pipework, valves, steel work, supports, conduit and other miscellaneous equipment shall be painted in accordance with ADCO Specification for Painting and Coating of new Equipment Doc. No.: 30-99-37-0013 (AON).

### III.26.3 Extent of coating at Interface between U/G and A/G

The anti-corrosion coating applied to buried pipework, shall terminate approximately 500 cm above the finish grade level. Contractor shall provide a clean interface between the below ground coating and above ground painting systems. Anti-corrosion coating on exposed sections of pipeline shall be suitably protected against ultra-violet degradation.
Contractor shall apply cold tapes at the interface as part of his scope of work.

### III.26.4 Installation of Isolating Joints

Isolating joints shall be installed above ground at the locations shown on the approved drawings.

Contractor shall ensure that all precautions necessary are exercised during handling and installation of the isolating joints to avoid damage and excessive stresses. The original pup length of the isolating joints shall not be reduced.

Following installation, the isolating joints and two field welds shall be painted in accordance with Specification for Painting.

During welding operations heat transfer towards the isolating joint shall be avoided. This can be achieved by keeping the joint cold using wetted rags and ensuring the joint is not allowed to dry.

Isolating joints shall be electrically tested before welding into the pipeline. The electrical conductance test shall be carried out using a Megger. The measured insulation resistance across the joint shall be in excess of one (1) Mega Ohm. Following installation and completion of all welding activities, the conductance tests shall be repeated to verify the assembly is undamaged.

## III.27 CONSTRUCTION DOCUMENTATION

Prior to and during construction operations, the Contractor shall submit construction documentation for Company review/ approval. As a minimum, the Contractor shall submit following documentation:

- Permit applications and/ or approvals
- Calculations for temporary works, buoyancy, etc.
- Construction drawings.
- Method Statements for the following activities:
  - Pre-Construction Survey
  - Clearing and Grading of ROW
  - Pipe Handling, Storage, Hauling and Stringing
  - Cold Bending
  - Lining Up and Welding
  - Field Joint Coating
  - Holiday Detection
  - NDT
  - Upheaval/ Lateral buckling check
  - Trench Excavation and Padding
  - Pipeline Lowering-in
  - Backfilling and Berming
  - Tie-ins and Hot Taps
  - Special Crossings
  - Auger Bore
  - Thrust Bore
  - Pipework Fabrication and Installation of Appurtenances
  - Cathodic Protection Facilities
  - Management of water (obtaining water, re-use and disposal)
  - As-built Survey
- Procedures for the following operations:
  - Padding
  - Backfilling
  - Welding & Inspection
  - Cleaning, Gauging and Hydrostatic Testing
  - Pre - Commissioning
  - Preservation of pipeline (if required by Company)
  - Commissioning
- Radiography weld maps
- Pipe and welding book
- NDT reports (radiography, ultrasonic and MPI).
- Material test results (coating, welding, painting, etc.)
- Material certificates, material receipts, etc.
- Vendor drawings
- Computerised potential logging test results
- Water sample analysis results

- QC Release Certificate for Hydrostatic Test.
- In addition to weekly and monthly progress report as per the AGREEMENT requirements, Contractor shall submit on daily basis the following reports, but not limited to:
- Separate Progress report of all crews.
- Daily welding results, repair and NDT results
- Material Receipt
- Damages
- Actual weather condition
- Accidents
- Any other report required by Contractor to monitor the Construction Progress.

Format for the report shall be agreed with Company.

Contractor shall submit to Company colour photographs of various construction activities/ operations at regular intervals. Size, number and frequency of photographs shall be mutually agreed prior to commencement of construction activities. Following completion of the Works, Contractor shall hand over all photographs to the Company.

Contractor shall note that there are restrictions on Photography in the vicinity of existing pipelines and terminals and hence adequate permits and clearance shall be obtained by Contractor.

## III.28 AS-BUILT DRAWINGS AND PIPE BOOK

### III.28.1 General

Contractor shall prepare 'As-Built' drawings of all Company issued drawings and all Contractor prepared drawings including vendor drawings. Drawings of all existing sites where new facilities have been installed and interfaced shall be updated to "As built" status by Contractor as per the direction of Company. As built data, it shall be collected progressively with installation activities.

Acceptance Criteria of Pipelines As Built; no changes in the engineered pipeline route (as per approved alignment sheets) are accepted without technical deviation as well as revised upheaval buckling & stress analysis calculations.

The 'As-Built' Alignment Sheets shall also contain the following information:

- Pipeline profile with respect to ground level
- Changes in wall thickness, materials
- Location and details of valves, insulating joints, fencing, etc.
- Location and details of buried services
- Location and details of road, water crossings, etc.
- Location and type of coating
- Location and type of weighting, anchoring
- Location and type of markers
- Location of further appurtenances (pig-signaller, etc.)
- Location of ROW and of pipeline with respect to ROW
- Location of CP test post, km pup piece
- Angle of bends and TP locations
- Type of soil
- Sand padding
- Actual pipe cover
- Type of road pavement
- Details of bank or plantation protection, number of insulators, seals, etc.
- Type of bends
- FOC Joint (Joint Pit) locations
- Section valve stations, if any

- Special fittings if any
- Special provisions such as protection/ identification slabs

### III.28.2 Equipment Nameplates

Contractor shall provide nameplates in accordance with ADCO standards for all permanent equipment items installed during the course of the Works. All texts shall be submitted to the Company for approval prior to manufacture. All instruments, manual valves and other permanent items shall be provided with SS tag plates by Contractor as approved by Company as part of his scope of work.

### III.28.3 Pipe Book

Contractor shall employ a proprietary verified computerised pipe tracking system to keep track of all pipe materials throughout the progress of the Work.

The pipe tracking system shall be capable of tracking the pipe materials from manufacture to final welding into the pipeline, have the capability to produce a bar chart output and be useable on a PC.

The pipe tracking system shall be used to supplement the Pipe Book. Every page of the pipe and welding book shall mention:

- Data relevant to the project and section thereof.
- Sequential number
- Length brought forward (for pipes and other materials)
- Length to bring forward (for pipes and other materials)
- Alignment sheet number and at least the location thereon of two welds on every page of the pipebook.
- Diameter of pipeline
- Length of each pipe
- Wall thickness
- Pipe number
- Identification number, certificate number
- Cut and re-numbered pipe ends
- Coating
- Date of stringing
- Date of welding
- Direction of working
- Weld number
- Welder number
- Type of welding, electrode, diameter
- Weld treatment
- Equipment used for radiography
- Limits of valve stations, water crossings, etc.
- Test pressure, date and test (hydrostatic)
- Location of Cathodic Protection test posts shall be included and identified by GPS coordinates.
- Length of section per page in line separated in the pipes including field bends and factory bends and/ or other in-line fittings
- Length to bring forward (pipes and other materials)
- Length brought forward (pipes and other materials)
- In order to achieve this Contractor shall identify all pipe elements. A sample format of the pipe book shall be submitted for Company approval.

## III.29 MATERIAL IDENTIFICATION

Upon receipt of material, Contractor shall issue serial numbers to all pipes, bends and fittings, etc., 2" diameter and greater. Each individual pipe length shall be measured and the measured length shall be clearly, marked on the outside of the pipe. Pipes to be bent shall be measured prior to bending. Identification markings (i.e. letter, number and length) shall be indelible.

Contractor shall compile material list for all permanent material (pipes, valves and fittings, etc.) to ensure traceability and material identification. The list shall contain, as a minimum, the following details for each item of permanent material:

- Stamped Pipe/ Fitting Numbers
- Cast/ Heat Number
- Painted Serial Numbers
- Individual Pipe Lengths
- Valve Manufacturer

Prior to cutting a pipe length, the Contractor shall, in the presence of the Company, transfer the painted serial number and stamped pipe number to either side of the proposed cut to be made. The Contractor shall record the changes immediately in the above referenced list, stating the (new) lengths.

The result shall be such that all pipes, bends & fittings, etc., of 2 inch diameter and greater bear clear, painted identification marks.

Contractor shall ensure all staff has been instructed not to remove parts which cannot be identified, except after permission by the Company.

As a general rule, parts must be marked as described above before being removed. Under no conditions shall unmarked parts be incorporated into the Work.

## III.30 PIPELINE BASELINE SURVEY

Contractor shall carry out baseline survey of the pipelines using intelligent pig. Intelligent Pig baseline Survey is not applicable for flowlines unless otherwise mentioned in the project Scope of Work for special flowlines such as high sour service Oil & Gas flowlines. Contractor shall prepare project specification for carrying out Baseline Survey and submit to Company'S Review & Approval. Project Specification for Baseline Survey and shall be controlled by a "permit to Work" from Company. In this specification, Contractor shall identity the types of pigs to be used.

Contractor shall engage specialist sub-Contractor capable in execution of the various methods of intelligent pigging. Contractor shall arrange for the baseline survey to be carried out within maximum 8 weeks of commissioning of the Pipelines.

Contractor shall ensure that all pigging facilities are designed in accordance with the extreme dimensions and operational characteristics of such inspection vehicles. Contractor shall specify pig-handling equipment which permits sufficient flexibility to enable effective loading and retrieval of all maintenance pig types without obstructing or compromising access for intelligent pigs.

Contractor shall submit the following to Company for approval, before placing the SUB-CONTRACT for the intelligent pig survey:

• Name of proposed SUB-Contractor

• Proposed SUB-Contractor'S method statement.

• Type of intelligent pigs to be employed.

Contractor shall ensure that the pigging SUB-Contractor follows the data reporting formats and acceptance criteria as per approved Specification for Baseline Survey.

After the completion of the intelligent pig survey SUBContractor's shall analyse the results for the new pipelines and issue a report containing the pigging data and the analysis of that data to inform Company of any anomalies as defined by the Baseline Survey Specification.

Contractor shall submit to Company a full pipeline condition report in the designated format within 4 weeks of the completion of the Intelligent pig Survey.

For pipeline anomalies reported by the Intelligent Pig Survey, Contractor shall verify the results with field measurements, using appropriate techniques and qualified personnel. The number of measurements required and measurement techniques to be used shall be determined in consultation with SUB-Contractor and shall be approved by Company.

Contractor shall repair all defects arising from line pipe transportation and Installation activities in the new pipelines identified by the Intelligent Pig Survey. Contractor shall carry out the repairs in a duration agreed with Company.

## III.31 PIPELINE CONSTRUCTION CHECK LIST

Construction check list including all construction activities as mentioned above in this specification shall be prepared to assure quality control of construction works. The check list can be prepared in many forms and also can be prepared for the major construction activities such as Crossings including all sub activities such as NOC, trenching, welding … etc. Check lists shall be prepared and submitted by Contractor to all pipeline projects for ADCO Construction and project management team (PMT) review and approval.

## APPENDIX A: LIST OF INPUT/ OUTPUT DOCUMENT FOR CONSTRUCTION ACTIVITY

| Item No. | Activity | Input | Output |
|---|---|---|---|
| 1 | Route Survey | Daily Route Survey Inspection | 1 Daily Route Survey Progress Report<br>2 Cumulative Progress<br>3 Graphical Progress Report. |
| 2 | ROW Clearing & Grading | Daily ROW Inspection Report | 1 Daily Route Survey Progress Report<br>2 Cumulative Progress<br>3 Graphical Progress Report |
| 3 | Trenching | Daily Trenching Inspection Report | 1 Daily Route Survey Progress Report<br>2 Cumulative Progress<br>3 Graphical Progress Report |
| 4 | Delivery of Pipe from Coater | 1 Bill of Landing<br>2 Inspection Certificates<br>3 Packing Lists<br>4 Master List (if any)<br>5 Barge Certificate<br>6 Pipe Coating Certificate<br>7 Tally Sheet<br>8 Loading/ Unloading Daily Inspection Report | 1 MRR (Material Receiving Report)<br>2 Coated Pipe List<br>3 Damaged Pipe List<br>4 OSDR (Over Short & Damage Report)<br>5 MRCR (Material Release for Construction Report) |
| 5 | Stockpile Activity | Stockpile Daily Inspection | 1 Stockpile Report Status<br>2 Total Pipe in Stockpile sorted by Thickness |
| 6 | Stringing | 1 Daily Stringing Inspection Report<br>2 Rejected Pipe Inspection Report | 1 Daily Stringing Progress Report<br>2 Cumulative Progress<br>3 Graphical Progress Report |
| 7 | Bending | Daily Bending Inspection Report | 1 Daily Bending Progress Report<br>2 Cumulative Progress<br>3 Graphical Progress Report |
| 8 | Welding | 1 WPS used (Welding Procedure Specification)<br>2 Daily Welding Inspection Report<br>3 Daily Tie-in Inspection Reports<br>4 Daily Re-weld Inspection Reports<br>5 Daily Welding Fabrication<br>6 Isometric Drawings for Fabrication | 1 Daily Welding (mainline, reweld & tie in) Progress Report<br>2 Cumulative Welding (mainline, re-weld & tie-in) Progress Report<br>3 Graphical Welding (mainline, re-weld & tie-in) Progress Report<br>4 List of Joints visually accepted/ rejected<br>5 List Reweld/ Cut-out<br>6 Total km Joint Status<br>7 Total Joints sorted by Thickness<br>8 Welder Performance – Analysis, Reports & Graph |

| Item No. | Activity | Input | Output |
|---|---|---|---|
| | | 7 Electrode Usage Report<br>8 Welder Certificate & ID No.<br>9 Welder identity by Root/ Hot/ Pass/ Fill Cap | 9 Weld (normal, repair, re-weld, cut-out) & Tie-in Chart |
| 9 | Pin Brazing/ TLP Installation | Daily Activity Inspection Report | 1 Reference Pipe No. shown in Pipe Book<br>2 Location tracing & Progress Reporting of TLP's |
| 10 | NDT Activity (RT/ AUT/ MUT/ MPI) | 1 NDT Activity Inspection Report<br>2 Defect – type, location & depth<br>3 X-Ray Equipment Certificate<br>4 Interprefer Level-2 Certificate | 1 Daily NDT Progress Report<br>2 Cumulative Progress Reports<br>3 Graphical Progress Report<br>4 Defect Type Analysis Reports<br>5 Welder performance and type of defects observed & list of welded joints |
| 11 | Weld Repair | Daily Weld Repair Inspection | 1 Daily Weld Repair Progress Report<br>2 Cumulative Progress Report<br>3 Graphical Progress Report<br>4 Percent Repairs Report<br>5 List Repaired Joints |
| 12 | Joint Coating | Daily Joint Coating Inspection | 1 Daily Joint Coating Progress Report<br>2 Cumulative Progress Report<br>3 Graphical Progress Report<br>4 Coating Defect Tracking (if any)<br>5 Compliance Report for Lowering |
| 13 | Holiday Test Activity | 1 Daily Holiday Test Inspection Report<br>2 Holiday Test Equipment Certificate | 1 Daily Holiday Test Progress Report<br>2 Cumulative Progress Report<br>3 Graphical Progress Report |
| 14 | Lowering | 1 Daily Lowering Inspection<br>2 Certificate for Lowering-in | 1 Daily Lowering Progress Report<br>2 Cumulative Progress Report<br>3 Graphical Progress Report |
| 15 | Back-filling | 1 Daily Back-filling Inspection Report<br>2 Construction Back-filling Approval | 1 Daily Back-filling Progress Report<br>2 Cumulative Progress Report |
| 16 | Restoration | Daily Restoration Inspection Report | Daily Progress Report |

| Item No. | Activity | Input | Output |
|---|---|---|---|
| 17 | Hydrotesting | Hydro-Test Reports & Results | Linking all hydro-test Reports |
| 18 | Berming | 1 Daily Gatch Laying and Installation<br><br>2 Berm Profile Completion | 1 Daily Progress Report<br>2 Cumulative Progress Report<br>3 Graphical Progress Report<br><br>4 Compaction results |
| 19 | Installation of markers | Marker Installation Log | 1 Daily Progress Report<br>2 Cumulative Progress Report<br>3 Graphical Progress Report |
| 20 | Post-construction survey | 1 Alignment Sheets<br><br>2 Installation Data/Pipe Book and Logs | 1 Survey Reports<br>2 Updated Pipe Books/Logs<br>3 As-Built Drawings |
| 21 | Cathodic Protection – Temporary & Permanent | 1 Temporary Anode Installation/Location<br><br>2 Permanent Cathodic Protection Installation/Location<br><br>3 Pin Brazing Work | 1 Daily Progress Reports<br><br>2 CP Location Drawings<br><br>3 CP Test Results<br><br>4 Pin Brazing Reports & Test Results |

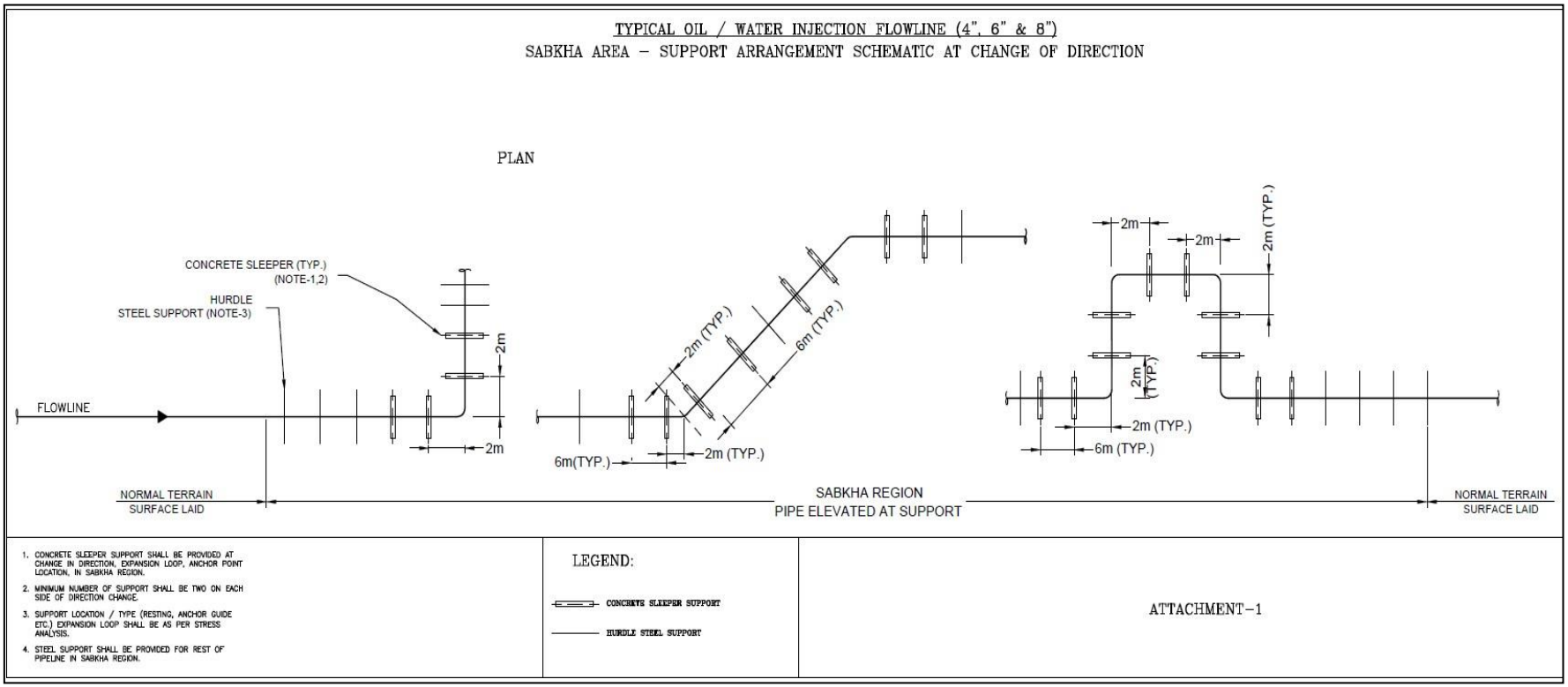
## APPENDIX B: TYPICAL DRAWINGS

| Drawing Title | Specification Number | Sheet |
|---|---|---|
| Typical Oil / Water Flowline (4", 6", & 8") | | |
| Typical Details of Asphalt Road Crossing | 30-99-22-0006 | 1 |
| Typical Details of Pipeline Gatch Road / Sand Track Crossing | 30-99-22-0006 | 2 |
| Typical Rig Crossing for New Buried Pipeline | 30-99-22-0006 | 3 |
| Typical Details of Underground Pipe Crossing | 30-99-22-0006 | 4 |
| Typical Details of Underground Cable Crossing | 30-99-22-0006 | 5 |
| Typical Details of Overhead Powerline Crossing | 30-99-22-0006 | 6 |
| Typical Details of Concrete Barrier for Asphalt Road Crossing | 30-99-22-0006 | 7 |
| Typical Details of Access Barrier for Road/Track/Rig Crossing | 30-99-22-0006 | 8 |
| Typical Details of Pipeline Identification Slabs and Cable Identification Slabs | 30-99-22-0006 | 9 |
| Typical Rig Crossing for New Buried Pipeline in Sabkha Area | 30-99-22-0006 | 10 |
| Typical Pipeline Marker & Warning Notice | 30-99-22-0006 | 11 |
| Typical Pipeline Trench Details | 30-99-22-0006 | 12 |
| Typical Details for Construction of Underground Pipelines in Sabkha Area | 30-99-22-0006 | 13 |
| Typical Details for Construction of Underground Pipelines in Sabkha Area near Bends | 30-99-22-0006 | 14 |
| Typical Berm Detail for Buried Pipeline in Sabkha Area Crossing | 30-99-22-0006 | 15 |
| Typical Detail Right of Way ( R.O.W) for Pipelines | 30-99-22-0006 | 16 |

| | | |
|---|---|---|
| Typical Asphalt Road Crossing Detail for Aboveground Pipelines/Flowlines | 30-99-22-0007 | 1 |
| Typical Rig Crossing Detail for Aboveground Pipelines/Flowlines | 30-99-22-0007 | 2 |
| Typical Track Crossing Detail for Above Ground Pipelines/Flowlines | 30-99-22-0007 | 3 |
| Typical Above Ground Flowline Crossing Details over Aboveground Pipelines/Flowlines | 30-99-22-0007 | 4 |
| Typical Overhead Powerline Crossing Detail for Aboveground Pipelines/Flowlines | 30-99-22-0007 | 5 |
| Typical Concrete Safety Barrier Detail for Aboveground Pipelines/Flowlines | 30-99-22-0007 | 6 |
| Typical Barrier Detail for Track / Rig Crossing Access of Aboveground Pipelines/Flowlines | 30-99-22-0007 | 7 |
| Typical Marker Post and Warning Notice Detail for Aboveground Pipelines/Flowlines | 30-99-22-0007 | 8 |
| Typical Pipe Hurdles Support Detail in Sabkha Area for Aboveground Pipelines/Flowlines | 30-99-22-0007 | 9 |
| Typical Sleeper Details in Sabkha Areas for Aboveground Pipelines/Flowlines | 30-99-22-0007 | 10 |

TYPICAL OIL / WATER INJECTION FLOWLINE (4", 6" & 8")

SABKHA AREA – SUPPORT ARRANGEMENT SCHEMATIC AT CHANGE OF DIRECTION




1. CONCRETE SLEEPER SUPPORT SHALL BE PROVIDED AT CHANGE IN DIRECTION, EXPANSION LOOP, ANCHOR POINT LOCATION, IN SABKHA REGION.
2. MINIMUM NUMBER OF SUPPORT SHALL BE TWO ON EACH SIDE OF DIRECTION CHANGE.
3. SUPPORT LOCATION / TYPE (RESTING, ANCHOR GUIDE ETC.) EXPANSION LOOP SHALL BE AS PER STRESS ANALYSIS.
4. STEEL SUPPORT SHALL BE PROVIDED FOR REST OF PIPELINE IN SABKHA REGION.

LEGEND:

CONCRETE SLEEPER SUPPORT

HURDLE STEEL SUPPORT

ATTACHMENT–1

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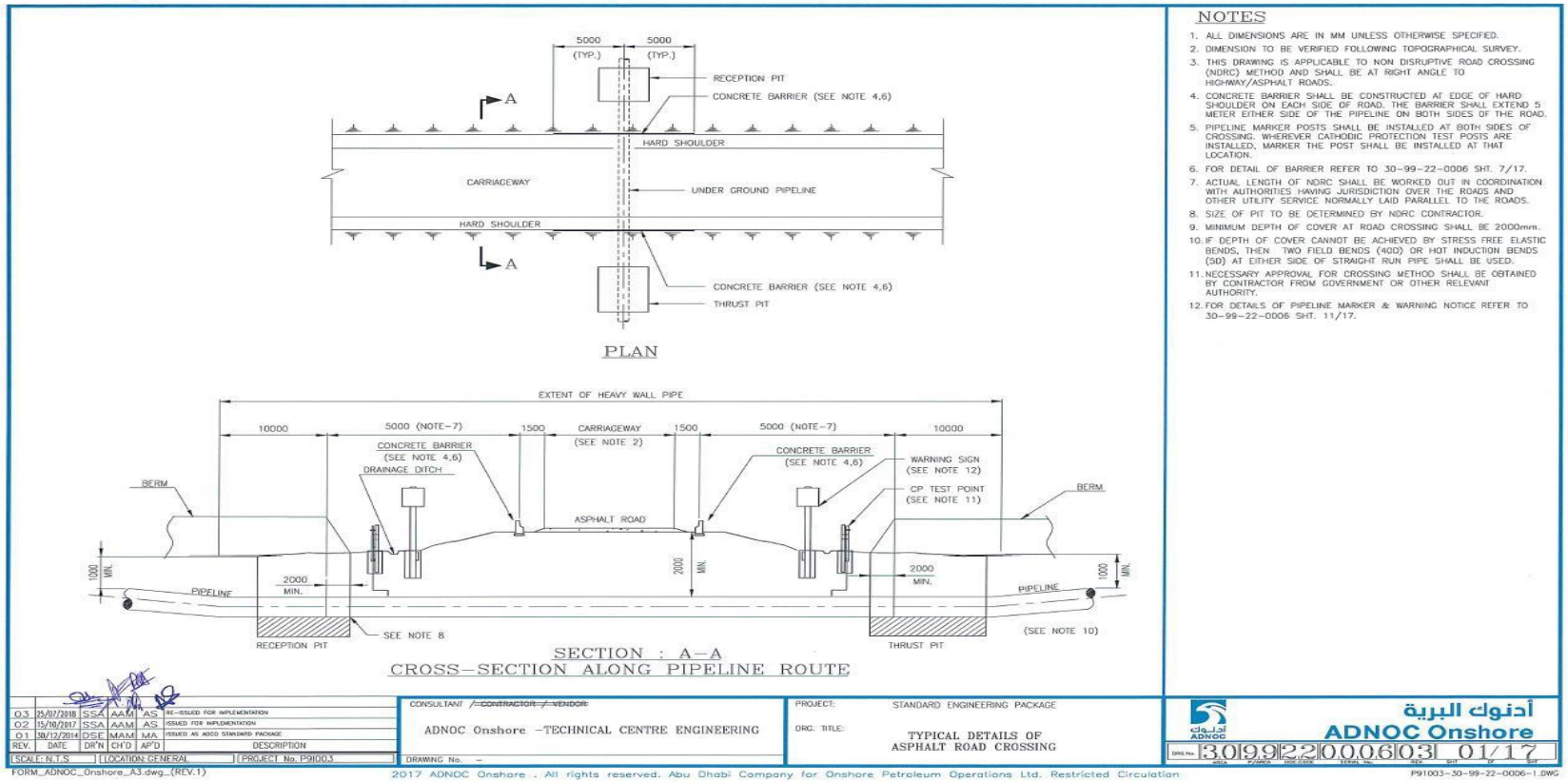


NOTES

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. DIMENSION TO BE VERIFIED FOLLOWING TOPOGRAPHICAL SURVEY.
3. THIS DRAWING IS APPLICABLE TO NON DISRUPTIVE ROAD CROSSING (NDRC) METHOD AND SHALL BE AT RIGHT ANGLE TO HIGHWAY/ASPHALT ROADS.
4. CONCRETE BARRIER SHALL BE CONSTRUCTED AT EDGE OF HARD SHOULDER ON EACH SIDE OF ROAD. THE BARRIER SHALL EXTEND 5 METER EITHER SIDE OF THE PIPELINE ON BOTH SIDES OF THE ROAD.
5. PIPELINE MARKER POSTS SHALL BE INSTALLED AT BOTH SIDES OF CROSSING. WHEREVER CATHODIC PROTECTION TEST POSTS ARE INSTALLED, MARKER THE POST SHALL BE INSTALLED AT THAT LOCATION.
6. FOR DETAIL OF BARRIER REFER TO 30-99-22-0006 SHT. 7/17.
7. ACTUAL LENGTH OF NDRC SHALL BE WORKED OUT IN COORDINATION WITH AUTHORITIES HAVING JURISDICTION OVER THE ROADS AND OTHER UTILITY SERVICE NORMALLY LAID PARALLEL TO THE ROADS.
8. SIZE OF PIT TO BE DETERMINED BY NDRC CONTRACTOR.
9. MINIMUM DEPTH OF COVER AT ROAD CROSSING SHALL BE 2000mm.
10. IF DEPTH OF COVER CANNOT BE ACHIEVED BY STRESS FREE ELASTIC BENDS, THEN TWO FIELD BENDS (40D) OR HOT INDUCTION BENDS (5D) AT EITHER SIDE OF STRAIGHT RUN PIPE SHALL BE USED.
11. NECESSARY APPROVAL FOR CROSSING METHOD SHALL BE OBTAINED BY CONTRACTOR FROM GOVERNMENT OR OTHER RELEVANT AUTHORITY.
12. FOR DETAILS OF PIPELINE MARKER & WARNING NOTICE REFER TO 30-99-22-0006 SHT. 11/17.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 0.3 | 25/07/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| 0.2 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 0.1 | 30/12/2014 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |

SCALE: N.T.S | LOCATION: GENERAL | PROJECT No. P91003

CONSULTANT /~~CONTRACTOR~~ / ~~VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL DETAILS OF ASPHALT ROAD CROSSING

أدنوك البرية ADNOC Onshore

DRG No. 30 99 22 0006 03 01/17

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P91003-30-99-22-0006-1.DWG

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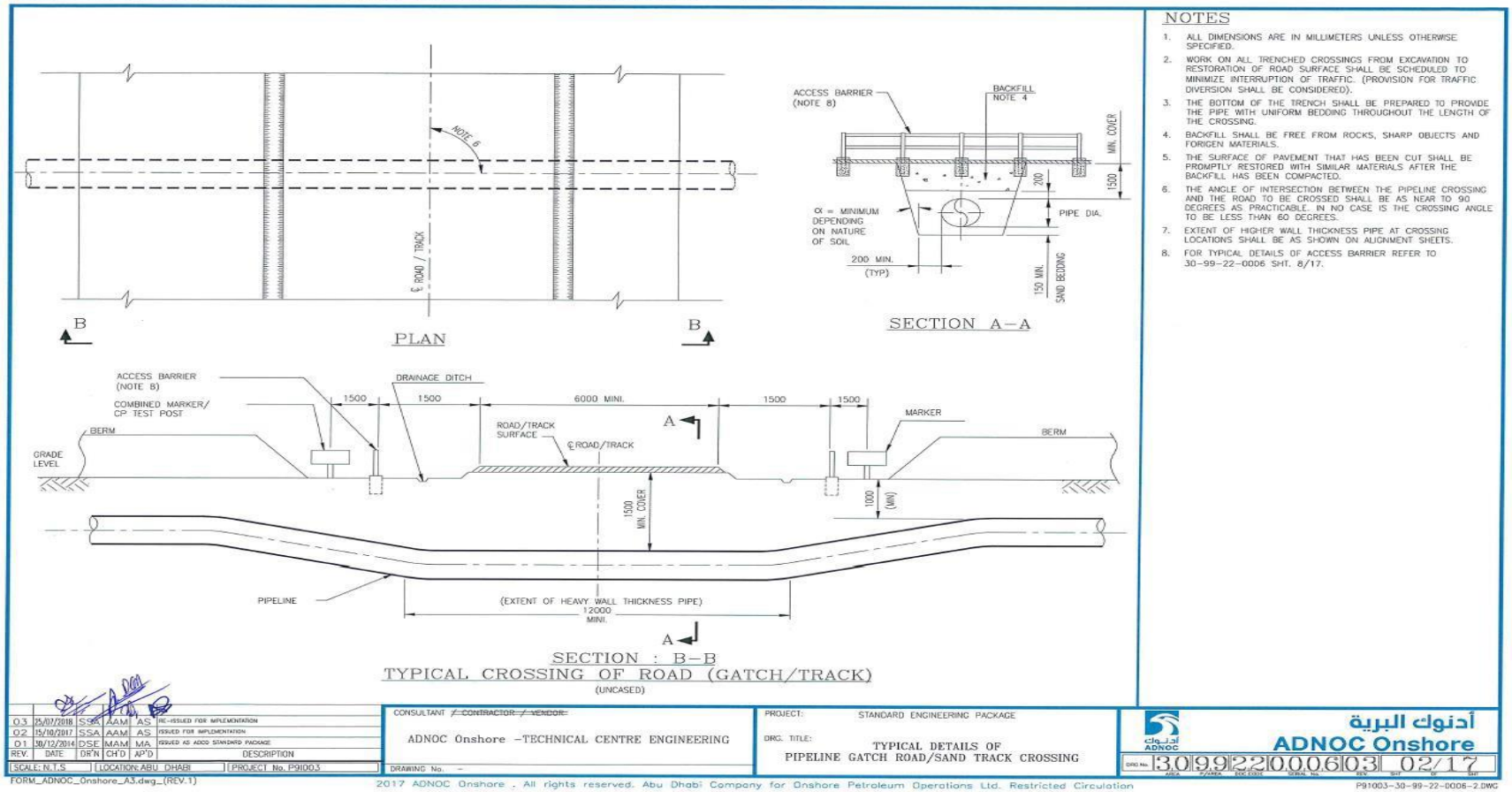


NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. WORK ON ALL TRENCHED CROSSINGS FROM EXCAVATION TO RESTORATION OF ROAD SURFACE SHALL BE SCHEDULED TO MINIMIZE INTERRUPTION OF TRAFFIC. (PROVISION FOR TRAFFIC DIVERSION SHALL BE CONSIDERED).
3. THE BOTTOM OF THE TRENCH SHALL BE PREPARED TO PROVIDE THE PIPE WITH UNIFORM BEDDING THROUGHOUT THE LENGTH OF THE CROSSING.
4. BACKFILL SHALL BE FREE FROM ROCKS, SHARP OBJECTS AND FORIGEN MATERIALS.
5. THE SURFACE OF PAVEMENT THAT HAS BEEN CUT SHALL BE PROMPTLY RESTORED WITH SIMILAR MATERIALS AFTER THE BACKFILL HAS BEEN COMPACTED.
6. THE ANGLE OF INTERSECTION BETWEEN THE PIPELINE CROSSING AND THE ROAD TO BE CROSSED SHALL BE AS NEAR TO 90 DEGREES AS PRACTICABLE. IN NO CASE IS THE CROSSING ANGLE TO BE LESS THAN 60 DEGREES.
7. EXTENT OF HIGHER WALL THICKNESS PIPE AT CROSSING LOCATIONS SHALL BE AS SHOWN ON ALIGNMENT SHEETS.
8. FOR TYPICAL DETAILS OF ACCESS BARRIER REFER TO 30-99-22-0006 SHT. 8/17.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 03 | 25/07/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| 02 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 01 | 30/12/2014 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |

SCALE: N.T.S | LOCATION: ABU DHABI | PROJECT No. P9100.3

CONSULTANT ~~/ CONTRACTOR / VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL DETAILS OF PIPELINE GATCH ROAD/SAND TRACK CROSSING

DRAWING No. –

ADNOC Onshore

DRG No. 30 99 22 0006 03 02/17

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P9100.3-30-99-22-0006-2.DWG

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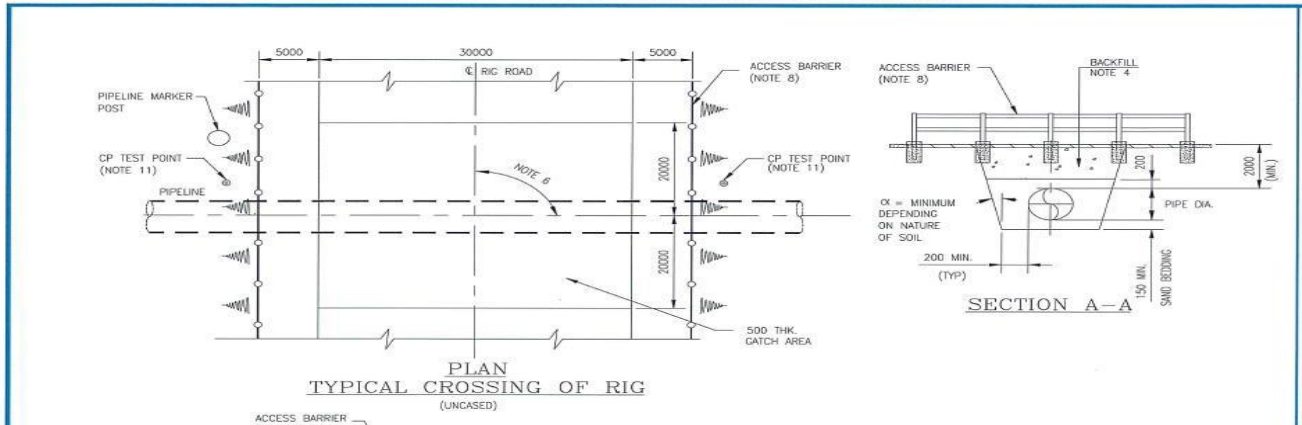


## NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. WORK ON ALL TRENCHED CROSSINGS FROM EXCAVATION TO RESTORATION OF RIG SURFACE SHALL BE SCHEDULED TO MINIMIZE INTERRUPTION OF TRAFFIC. (PROVISION FOR TRAFFIC DIVERSION SHALL BE CONSIDERED).
3. THE BOTTOM OF THE TRENCH SHALL BE PREPARED TO PROVIDE THE PIPE WITH UNIFORM BEDDING THROUGHOUT THE LENGTH OF THE CROSSING.
4. BACKFILL SHALL BE FREE FROM ROCKS, SHARP OBJECTS AND FORIGEN MATERIALS.
5. THE SURFACE OF PAVEMENT THAT HAS BEEN CUT SHALL BE PROMPTLY RESTORED WITH SIMILAR MATERIALS AFTER THE BACKFILL HAS BEEN COMPACTED.
6. THE ANGLE OF INTERSECTION BETWEEN THE PIPELINE CROSSING AND THE ROAD TO BE CROSSED SHALL BE AS NEAR TO 90 DEGREES AS PRACTICABLE. IN NO CASE IS THE CROSSING ANGLE TO BE LESS THAN 60 DEGREES.
7. EXTENT OF HIGHER WALL THICKNESS PIPE AT RIG CROSSING LOCATIONS SHALL BE AS SHOWN ON ALIGNMENT SHEETS.
8. FOR TYPICAL DETAILS OF ACCESS BARRIER REFER 30-99-22-0006 SHT. 8/17
9. FOR TYPICAL DETAILS OF PIPELINE MARKER POST REFER DRAWING No. 30-99-22-0006 SHT. 11/17
10. SLOPE OF THE RIG ROAD ACROSS THE PIPELINE (AT RIG CROSSING) SHALL BE 1:20 MIN.
11. CATHODIC PROTECTION CP TEST POST SHALL BE INSTALLED AS PER TYPICAL DETAIL DRAWING NO. 30-99-62-0001 SHT 9/80 AND ENGINEERING PROCEDURE NO. 30-99-90-0279.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 03 | 25/07/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| 02 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 01 | 30/12/2014 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |

SCALE: N.T.S | LOCATION: ABU DHABI | PROJECT No. P91003

~~CONSULTANT / CONTRACTOR~~ / VENDOR

ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL RIG CROSSING FOR NEW BURIED PIPELINE

أدنوك البرية
ADNOC Onshore

DRG No. 30 99 22 0006 03 03/17

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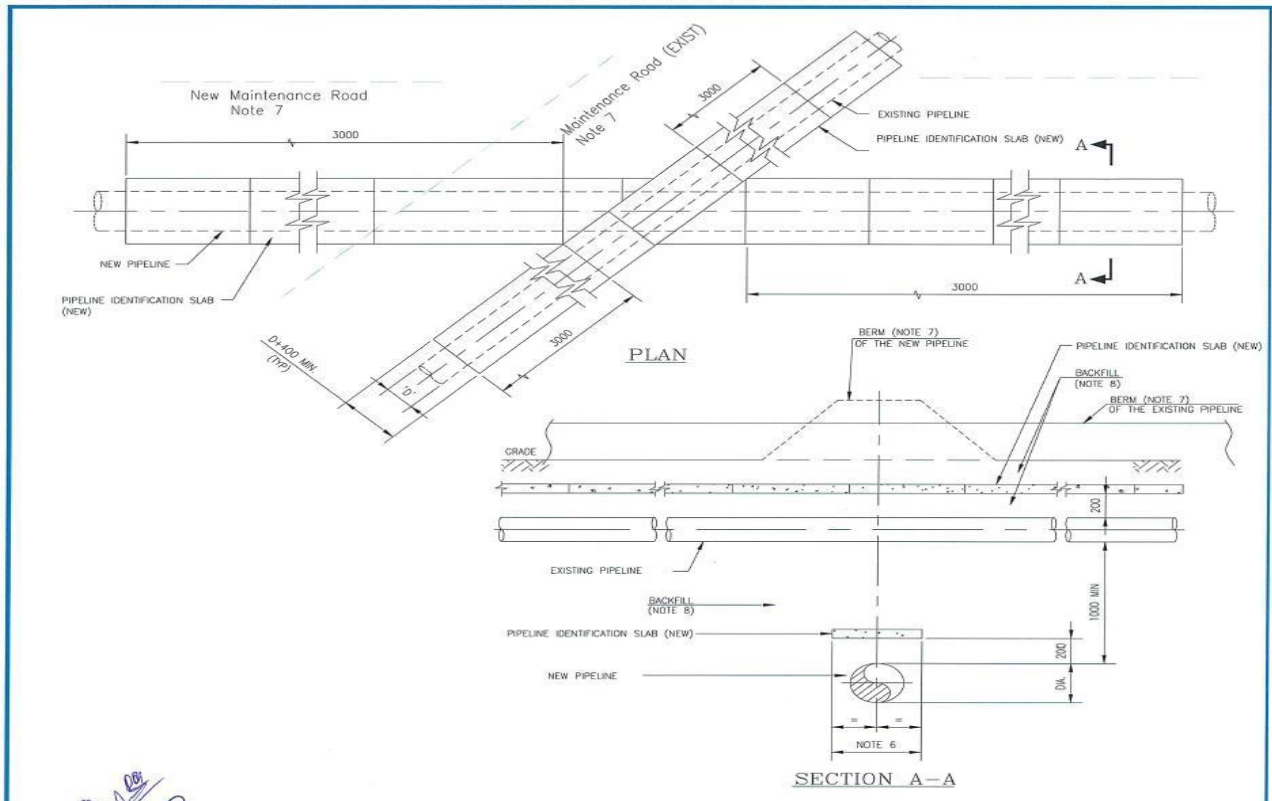


NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. SUITABLE CATHODIC PROTECTION BONDING SHALL BE PROVIDED BETWEEN CROSSING PIPELINES.
3. PIPELINE IDENTIFICATION SLABS ON TOP OF BOTH PIPELINES SHALL BE PROVIDED BY CONTRACTOR.
4. THE OWNER OF THE EXISTING PIPELINE(S) SHALL BE NOTIFIED IN SUFFICIENT TIME TO WITNESS EXCAVATION OR INSTALLATION.
5. PRIOR TO EXCAVATION, ALL EXISTING PIPELINE(S) SHALL BE EXACTLY LOCATED AND EXPOSED BY HAND TOOLS.
6. FOR PIPELINE IDENTIFICATION SLAB DETAILS, REFER TO 30-99-22-0006 SHT. 9/17.
7. BERM OF THE EXISTING PIPELINE SHALL BE REINSTATED TO ITS ORIGINAL CONDITIONS AND IT SHALL BE CONTINUOUS. NEW PIPELINE BERM SHALL BE DISCONTINUOUS AT THE EXISTING PIPELINE ROW.
8. BACKFILL SHALL BE FREE FROM ROCKS, SHARP OBJECTS AND FORIGEN MATERIALS.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 0.3 | 25/07/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| 0.2 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 0.1 | 04/08/2014 | AN | HSK | MA | ISSUED AS ADCO STANDARD PACKAGE |

SCALE: N.T.S | LOCATION: ABU DHABI | PROJECT No. P91003

CONSULTANT / ~~CONTRACTOR~~ / ~~VENDOR~~:
ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL DETAILS OF UNDERGROUND PIPE CROSSING

أدنوك البرية
ADNOC Onshore

DRG.No. 30 99 22 0006 03 04/17

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P91003-30-99-22-0006-4.DWG

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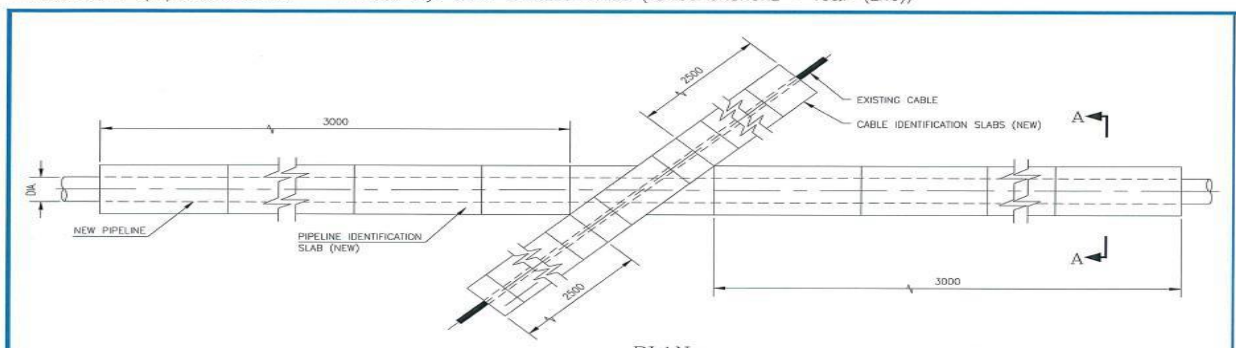
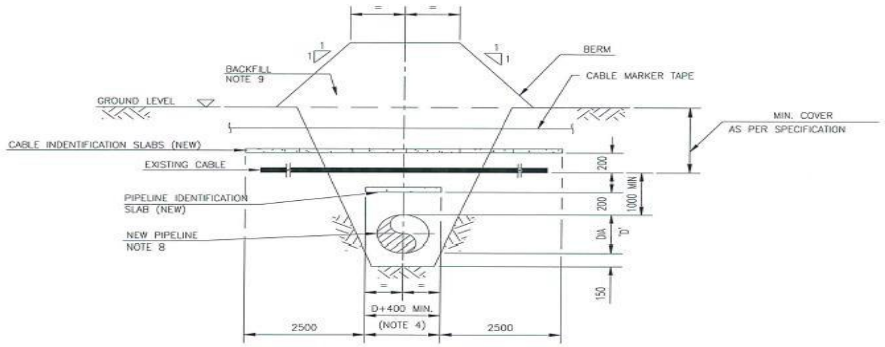



PLAN




SECTION A–A

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. CABLE IDENTIFICATION SLABS AND PIPELINE IDENTIFICATION SLABS SHALL BE PROVIDED BY CONTRACTOR TO THE REQUIREMENTS OF THIS DRAWING.
3. FOR CROSSING OF UNDERGROUND TELEPHONE CABLES, THE REQUIREMENT OF ETISALAT WITH RESPECT TO CABLE PROTECTION VIZ. SLEEVING OF CABLE, ETC. SHALL BE COMPLIED.
4. THE CROSSING SHALL BE NEAR TO 90 DEGREE ANGLE AS PRACTICABLE AS POSSIBLE, BUT IN ANY CASE IT SHALL NOT BE LESS THEN 60 DEGREE.
5. MANUAL EXCAVATION SHALL BE CARRIED OUT ONLY IN THE PRESENCE OF CABLE OWNERS, REPRESENTATIVE. MECHANICAL EXCAVATION IS NOT ALLOWED.
6. FOR PIPELINE IDENTIFICATION SLABS AND CABLE IDENTIFICATION SLABS DETAILS REFER DRG.NO. 30-99-22-0006 SHT. 9/17.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING ALL EXISTING CABLES SHOWN OR NOT SHOWN IN THE PLANS. THIS SHALL INCLUDE MANUAL EXCAVATION TO AVOID DAMAGE TO CABLES.
8. NEW PIPELINE WALL THICKNESS SHALL BE INCREASED ONLY IF IT WILL CROSS BENEATH EXISTING CABLE TRACK.
9. BACKFILL SHALL BE FREE FROM ROCKS, SHARP OBJECTS AND FORIGEN MATERIALS.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 0.3 | 25/07/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| 0.2 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 0.1 | 30/12/2014 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |

SCALE: N.T.S | LOCATION: ABU DHABI | PROJECT No. P91003

CONSULTANT / ~~CONTRACTOR / VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL DETAILS OF UNDERGROUND CABLE CROSSING

أدنوك البرية ADNOC Onshore

DRG. No. 30 99 22 0006 03 REV 05 SHT 17

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P91003-30-99-22-0006-5.DWG

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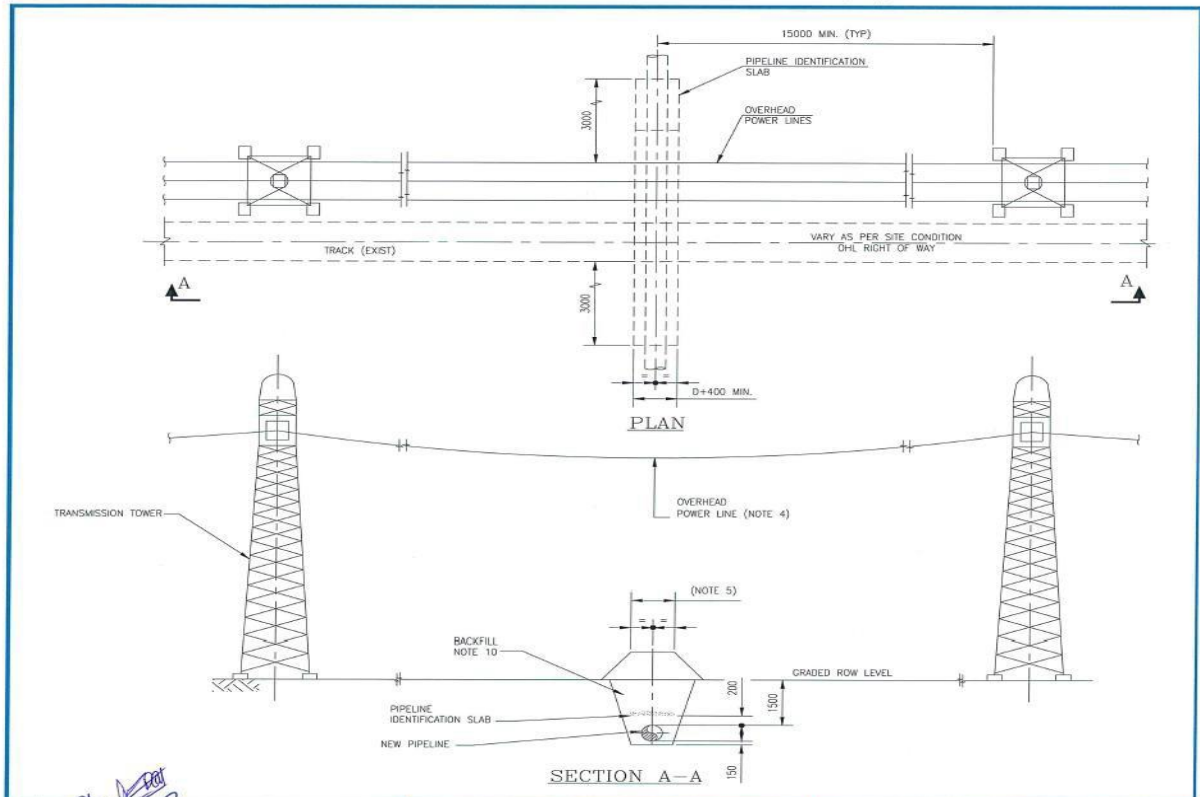


## NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. SUITABLE MEASURES SHALL BE TAKEN FOR THE PROTECTION OF THE OH POWERLINE AND SECURITY OF PERSONNEL IN ACCORDANCE WITH PIPELINE CONSTRUCTION SPECIFICATION.
3. PERMANENT WARNING SIGNBOARDS SHALL BE INSTALLED ON THE PIPELINE RIGHT OF WAY ON EITHER SIDE OF THE OVERHEAD POWER LINE CROSSING.
4. CONTRACTOR SHALL CHECK MINIMUM GROUND CLEARANCE AT EACH OVERHEAD POWER LINE CROSSING SPAN. MEASUREMENT SHALL BE MADE TO LOWEST CONDUCTOR AT MAXIMUM TEMPERATURE IN STILL AIR. ANY SPAN NOT COMPLYING WITH THE REQUIREMENTS OF TABLE 1 SHALL BE REPORTED TO THE COMPANY.

TABLE – 1

| SYSTEM VOLTAGE (kv) | MINIMUM HEIGHT(m) |
|---|---|
| 11/33 | 12.50 |
| 132 | 13.50 |
| 220 | 14.00 |
| 440 | 16.00 |

5. FOR DETAILS OF PIPELINE IDENTIFICATION SLABS AND CABLE IDENTIFICATION SLABS REFER TO 30-99-22-0006 SHT. 9/17.
6. CONTRACTOR SHALL CARRY OUT DETAILED CP CALCULATIONS FOR EACH CROSSING AND ADOPT NECESSARY MITIGATION MEASURES FOR PROTECTING PIPELINE AND TO PREVENT INTERFERENCE WITH PIPELINE CP SYSTEM. ALL CALCULATIONS AND PROPOSED MITIGATION MEASURES SHALL BE APPROVED BY COMPANY.
7. IN AREAS WHERE HARD MATERIAL SUCH AS ROCK GRAVEL ETC. ARE ENCOUNTERED SUFFICIENT COMPACTED FINE SAND APPROVED BY THE COMPANY SHALL BE PLACED ALL AROUND THE PIPE AND TO MINIMUM DEPTH OF 150MM, BELOW THE PIPE.
8. EXTENT OF EXTRA THICK PIPE FOR OHL RIGHT OF WAY CROSSING IS TO BE CONSIDERED AS PER SH. 02/17.
9. IT IS MANDATORY TO CALCULATE THE MINIMUM SEPARATION HEIGHT BETWEEN PIPELINE CONSTRUCTION EQUIPMENT WITH OH POWERLINE TO AVOID RISKS OF THE ELECTRICAL SHOCKS. TRA AND ePTW SHALL ADDRESS THE CONSTRUCTION UNDER OHL SPECIFICALLY.
10. BACKFILL SHALL BE FREE FROM ROCKS, SHARP OBJECTS AND FORIGEN MATERIALS.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 03 | 25/07/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| 02 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 01 | 30/12/2014 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |

SCALE: N.T.S. | LOCATION: ABU DHABI | PROJECT No. P91003

CONSULTANT: ~~CONTRACTOR / VENDOR:~~
ADNOC Onshore –TECHNICAL CENTRE ENGINEERING
DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE
DRG. TITLE: TYPICAL DETAILS OF OVERHEAD POWERLINE CROSSINGS

أدنوك البرية
ADNOC Onshore
DRG No. 30 99 22 0006 03 06/17

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P91003-30-99-22-0006-6.DWG

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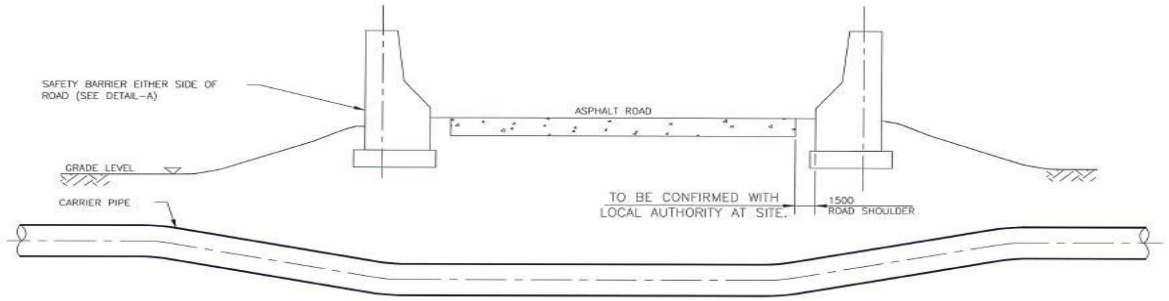
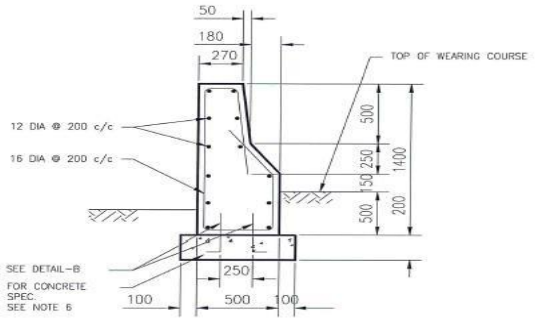
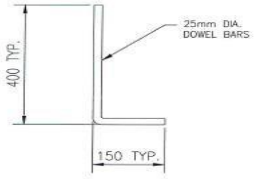



TYPICAL ROAD CROSSING CROSS–SECTION
(NOTE 2)




DETAIL–A
CONCRETE BARRIER




DETAIL–B
TYPICAL DOWEL BAR TO BE PLACED AT EVERY 1000mm

NOTES

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. FOR TYPICAL DETAILS OF ROAD CROSSING REFER TO 30–99–22–0006 SHT. 1/17.
3. PIPELINE SAFETY BARRIER TO INCORPORATE SUITABLE TRANSITION.
4. CONCRETE SAFETY BARRIERS TO BE PROVIDED FOR A LENGTH SPECIFIED BY RELEVANT AUTHORITIES AND AS REQUIRED BY THE SITE CONDITIONS, MINIMUM LENGTH SHALL BE 3000mm.
5. DETAILS OF PRE–CASTING AND LIFTING ARRANGEMENT SHALL BE SUBMITTED AT CONSTRUCTION STAGE.
6. SAFETY BARRIERS SHALL BE COATED AS PER CONCRETE PROTECTION REQUIREMENT AS PER COMPANY SPECIFICATION. FINAL COATS FOR ABOVE GROUND PART SHALL BE STRIPED COLORS AS PER COMPANY SAFETY REQUIREMENT. USE C20 FOR BLINDING AND C40 FOR STRUCTURAL CONCRETE.
7. DIMENSIONS SHOWN IN DETAIL–A FOR CONCRETE SAFETY BARRIER AND REQUIRED FOUNDING DEPTH SHALL BE FURTHER CONFIRMED BY EPC CONTRACTOR BASED ON SOIL PROPERTIES DURING EPC PHASE AND SUBJECT TO COMPANY APPROVAL.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 03 | 25/07/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| 02 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 01 | 30/12/2014 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |

SCALE: N.T.S | LOCATION: ABU DHABI | PROJECT No. P91003

CONSULTANT ~~/ CONTRACTOR / VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL DETAIL FOR CONCRETE BARRIER FOR ASPHALT ROAD CROSSING

أدنوك البرية ADNOC Onshore

DRG. No. 30 99 22 0006 03 07/17

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P91003–30–99–22–0006–7.DWG

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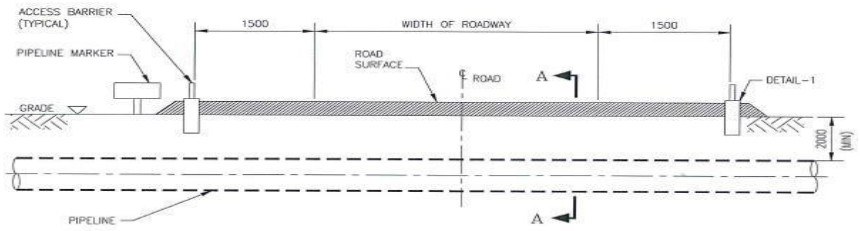
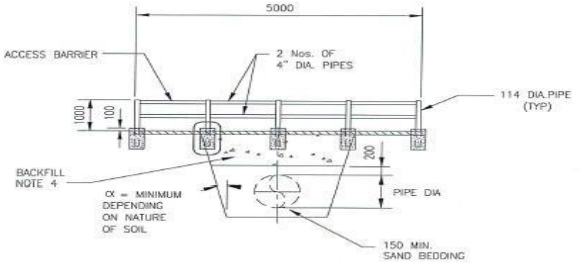
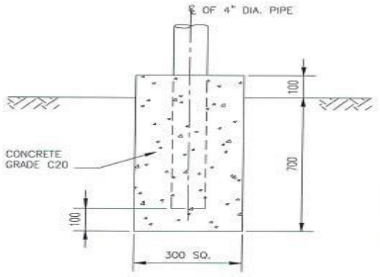



TYPICAL CROSS SECTION OF TRACK/RIG CROSSING
(NOTE 3)




SECTION A–A




DETAIL–1
TYPICAL FOUNDATION DETAIL

NOTES
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. ACCESS BARRIERS SHALL BE HOT DIP GALVANIZED AND PAINTED AS PER ADNOC ONSHORE SPECIFICATION No. 30-44-37-0013.
3. FOR TYPICAL DETAILS OF RIG / TRACK CROSSING REFER TO DRG NO.30-99-22-0006 SHT. 02/17 AND 03/17.
4. BACKFILL SHALL BE FREE FROM ROCKS, SHARP OBJECTS AND FORIGEN MATERIALS.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 03 | 25/07/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| 02 | 25/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 01 | 30/12/2014 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |

SCALE: NTS | LOCATION: GENERAL | PROJECT No. P91003

CONSULTANT / ~~CONTRACTOR / VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL DETAILS OF ACCESS BARRIER FOR TRACK/RIG CROSSING

أدنوك البرية ADNOC Onshore

DWG No. 3 0 9 9 2 2 0 0 0 6 0 3 _ 0 8 / 1 7

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P91003-30-99-22-0006-8.DWG

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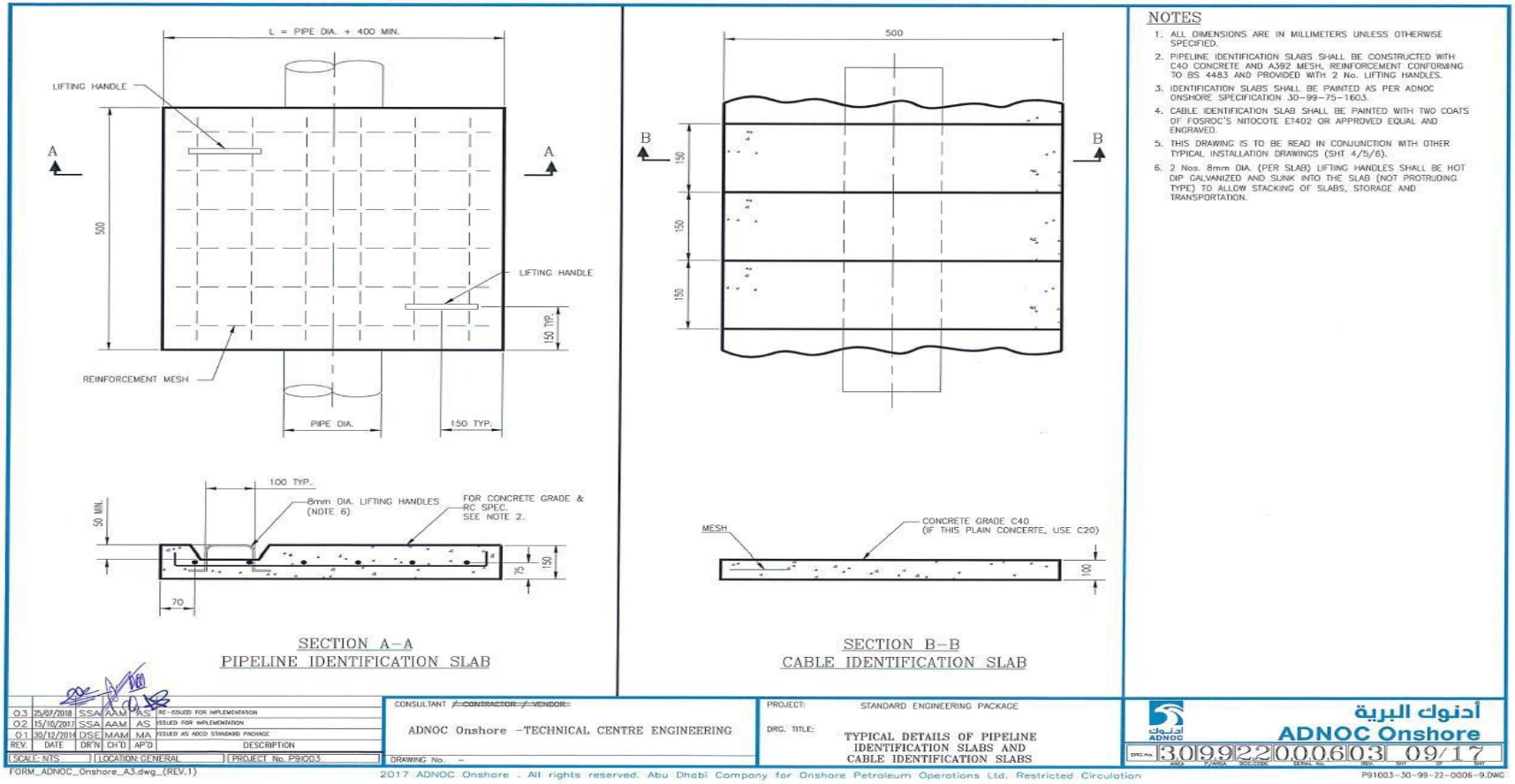

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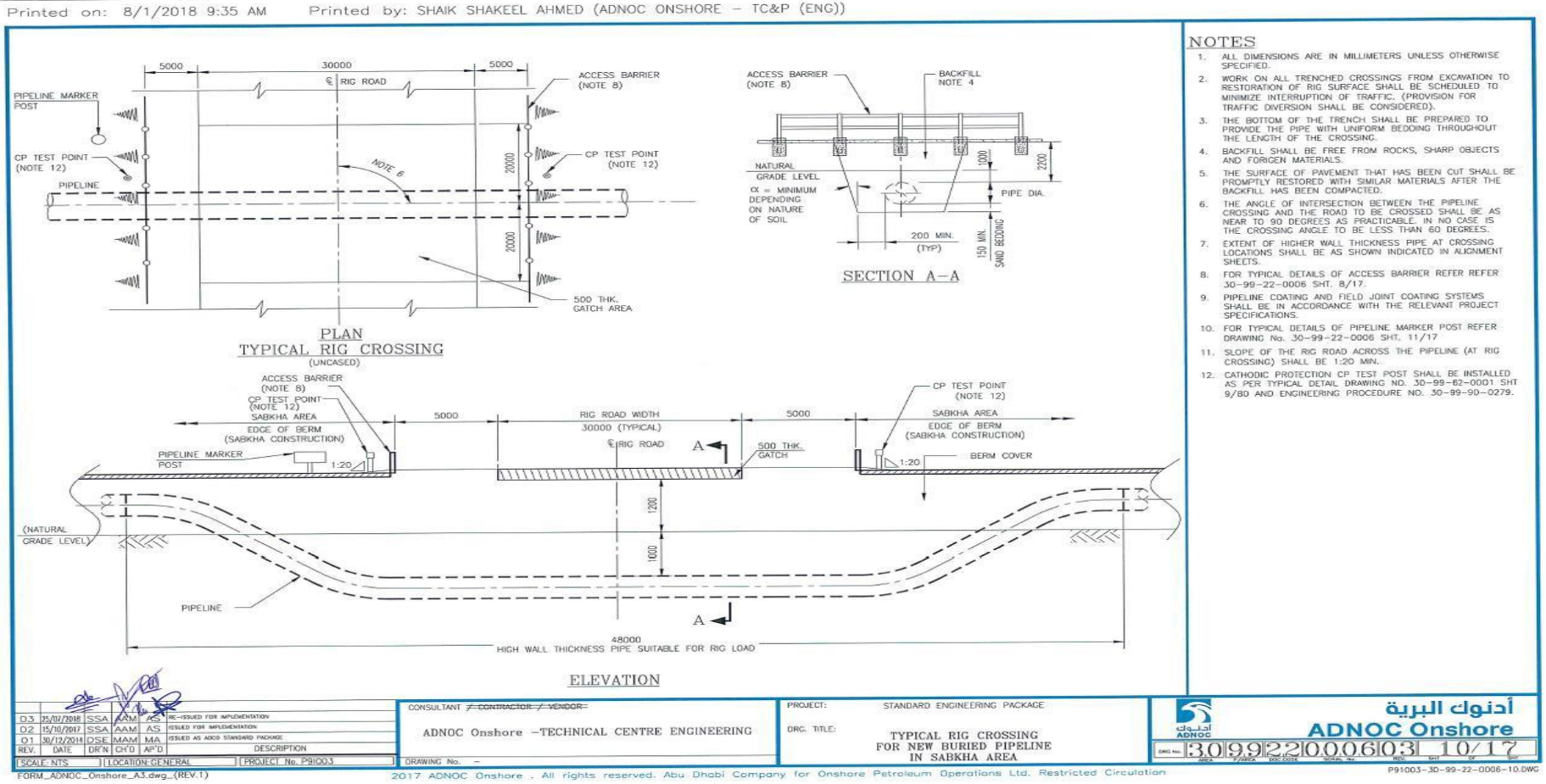


NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. WORK ON ALL TRENCHED CROSSINGS FROM EXCAVATION TO RESTORATION OF RIG SURFACE SHALL BE SCHEDULED TO MINIMIZE INTERRUPTION OF TRAFFIC. (PROVISION FOR TRAFFIC DIVERSION SHALL BE CONSIDERED).
3. THE BOTTOM OF THE TRENCH SHALL BE PREPARED TO PROVIDE THE PIPE WITH UNIFORM BEDDING THROUGHOUT THE LENGTH OF THE CROSSING.
4. BACKFILL SHALL BE FREE FROM ROCKS, SHARP OBJECTS AND FORIGEN MATERIALS.
5. THE SURFACE OF PAVEMENT THAT HAS BEEN CUT SHALL BE PROMPTLY RESTORED WITH SIMILAR MATERIALS AFTER THE BACKFILL HAS BEEN COMPACTED.
6. THE ANGLE OF INTERSECTION BETWEEN THE PIPELINE CROSSING AND THE ROAD TO BE CROSSED SHALL BE AS NEAR TO 90 DEGREES AS PRACTICABLE. IN NO CASE IS THE CROSSING ANGLE TO BE LESS THAN 60 DEGREES.
7. EXTENT OF HIGHER WALL THICKNESS PIPE AT CROSSING LOCATIONS SHALL BE AS SHOWN INDICATED IN ALIGNMENT SHEETS.
8. FOR TYPICAL DETAILS OF ACCESS BARRIER REFER REFER 30-99-22-0006 SHT. 8/17.
9. PIPELINE COATING AND FIELD JOINT COATING SYSTEMS SHALL BE IN ACCORDANCE WITH THE RELEVANT PROJECT SPECIFICATIONS.
10. FOR TYPICAL DETAILS OF PIPELINE MARKER POST REFER DRAWING No. 30-99-22-0006 SHT. 11/17
11. SLOPE OF THE RIG ROAD ACROSS THE PIPELINE (AT RIG CROSSING) SHALL BE 1:20 MIN.
12. CATHODIC PROTECTION CP TEST POST SHALL BE INSTALLED AS PER TYPICAL DETAIL DRAWING NO. 30-99-62-0001 SHT 9/80 AND ENGINEERING PROCEDURE NO. 30-99-90-0279.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| D.3 | 25/11/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| D.2 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| D.1 | 30/12/2014 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |

SCALE: NTS | LOCATION: GENERAL | PROJECT No. P91003

CONSULTANT ~~/ CONTRACTOR / VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL RIG CROSSING FOR NEW BURIED PIPELINE IN SABKHA AREA

أدنوك البرية ADNOC Onshore

DWG No. 30 99 22 0006 03 10/17

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P91003-30-99-22-0006-10.DWG

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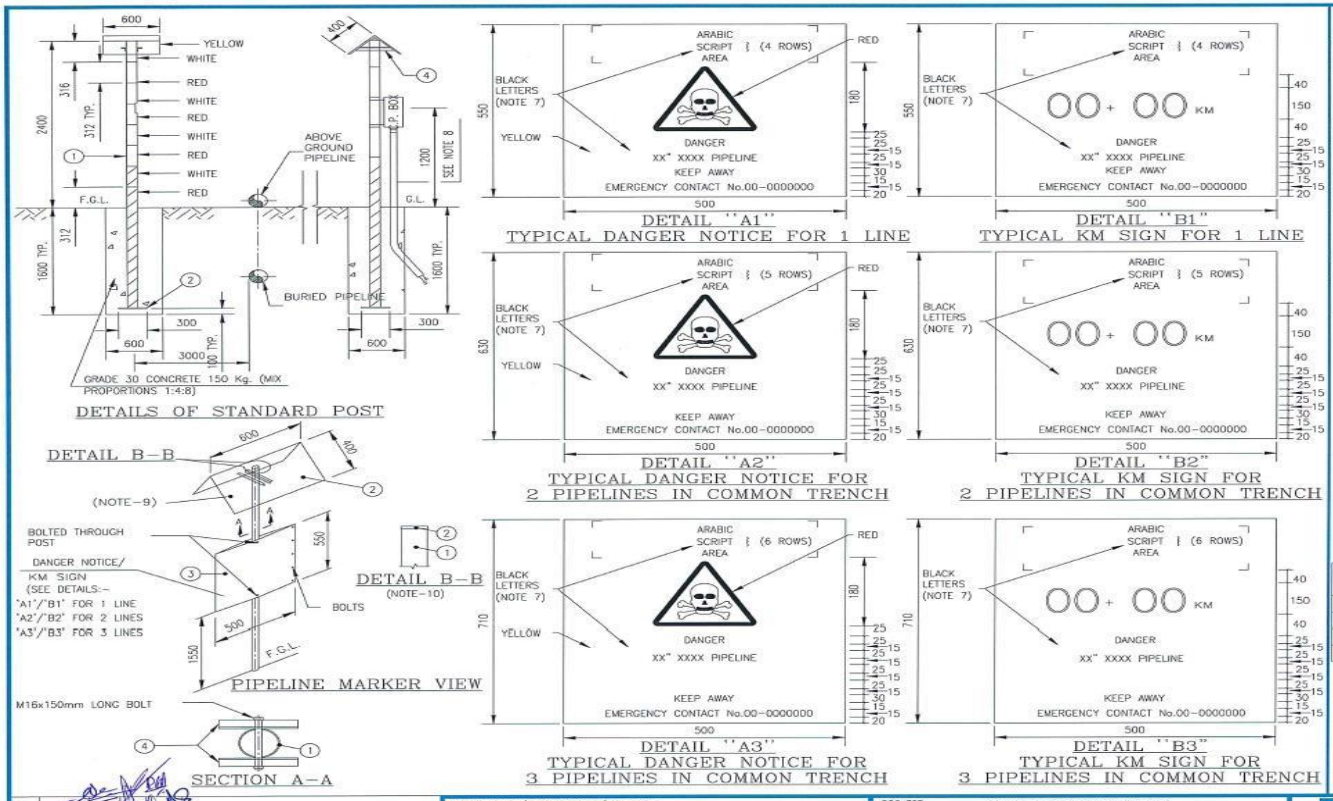


NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. MARKER POSTS SHALL BE INSTALLED AT EVERY ONE KILOMETER INTERVAL THROUGHOUT THE PIPELINE ROUTE, AT ROAD CROSSINGS, AT CROSSINGS OF EXISTING PIPELINES AND AT CHANGE OF HORIZONTAL DIRECTION.
3. PAINTING OF STEEL STRUCTURES AND SIGN POST SHALL BE AS PER SPECIFICATION No. 30–99–37–0013 REV. 2.
4. THE ABOVE GROUND SECTION OF PIPE FOR SIGN POST SHALL BE PAINTED WITH CORROSION RESISTANT PAINT OF ALTERNATE BANDS OF RED AND WHITE COLOR.
5. ALL RIVETS SHALL BE GALVANIZED.
6. DETAIL "A" AND "B" WARNING NOTICE SHALL BE USED EITHER SIDE OF MARKER POST.
7. DESCRIPTION SHALL SUIT TO PIPELINE DIAMETER AND SERVICE DETAILS. CONTRACTOR SHALL OBTAIN CLEARANCE FROM ADNOC ONSHORE FOR THE SCRIPT ON THE MARKER PLATES.
8. COMBINED MARKER/C.P. TEST POINT TYPE SHALL BE INSTALLED WHERE REQUIRED.
9. AERIAL MARKER PLATES SHALL BE PROVIDED AT KILOMETER CHAINAGE. KILOMETER NO. SHALL BE PAINTED OVER BOTH SIDES OF AERIAL MARKER PLATE.
10. THE END CAP (DETAIL B–B ) SHALL BE PROVIDED WHERE THERE IS NO AERIAL MARKER PLATE.

MATERIALS FOR STANDARD POST

| ITEM No | DESCRIPTION |
|---|---|
| 1 | 4" PIPE API 5L GR.B SMLS/A106 GR.B, W.T. 6MM |
| 2 | 8mm THICK M.S. PLATE |
| 3 | 10mm THICK M.S. PLATE |
| 4 | FABRICATED FROM 75 x 75 x 8mm M.S.ANGLE |

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 03 | 25/07/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| 02 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 01 | 30/12/2014 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |

SCALE: NTS | LOCATION: GENERAL | PROJECT No. P91003

CONSULTANT / ~~CONTRACTOR / VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL PIPELINE MARKER & WARNING NOTICE

أدنوك البرية ADNOC Onshore

DRG. No. 30 99 22 0006 03 11/17

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P91003-30-99-22-0006-11.DWG

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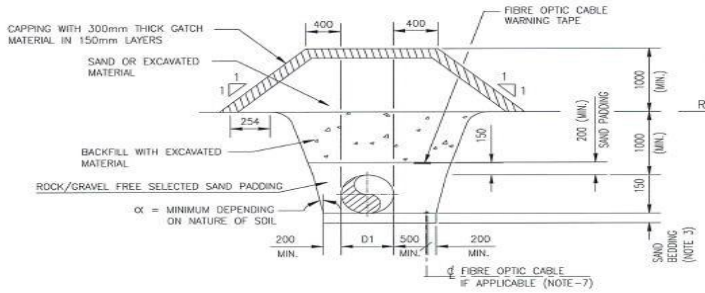
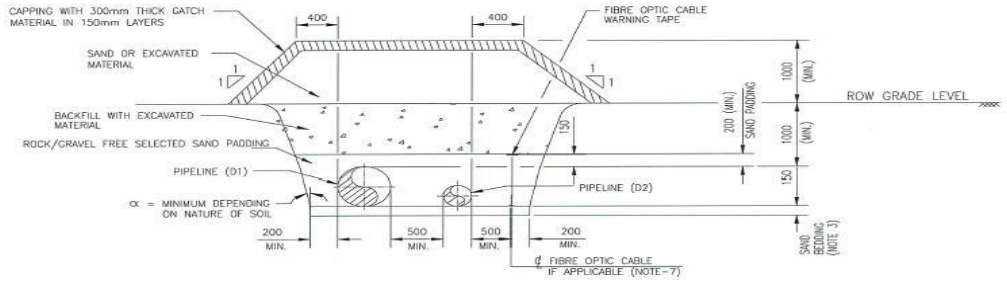



PIPELINE TRENCH DETAIL FOR SINGLE PIPELINE




PIPELINE TRENCH DETAIL FOR MULTIPLE PIPELINES
(SEE NOTE – 5)

## NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. GATCH SHALL BE PROVIDED AS PER SITE PREPARATION AND EARTH WORK PROJECT REQUIREMENTS SPECIFICATIONS.
3. IN GENERAL THE TERRAIN IS SANDY OR SABKHA. A COMPACTED PADDING OF 150mm MINIMUM IS REQUIRED AT BOTTOM OF TRENCH.
4. PIPELINE TRENCH CONSTRUCTION SHALL BE IN ACCORDANCE WITH SPECIFICATION FOR PIPELINE CONSTRUCTION 30-99-12-0028.
5. INCASE MORE THAN TWO PIPELINES ARE INSTALLED IN THE SAME TRENCH, THE MINIMUM SEPARATION BETWEEN PIPELINES SHALL BE AT LEAST 500mm BASED ON PIPELINES DIAMETERS; REFER TO PIPELINE BASIS OF DESIGN (UNDERGROUND PIPELINE SYSTEMS) 30-99-12-0032
6. D1, D2,... – OUTSIDE DIAMETER OF PIPELINES.
7. IN CASE NO FIBRE OPTIC CABLE, 500 MM MIN. CLEARANCE SHOWN SHALL NOT BE APPLICABLE.
8. MINIMUM DISTANCE AND NUMBER OF PIPELINES IN THE COMMON TRENCH SHALL BE AS BELOW:

| PIPELINES SERVICE TYPES | NO. (MAX.) | SIZE (IN) | DISTANCE (MM) |
|---|---|---|---|
| Gas Flowlines (production and Injection) | 3 | 8IN AND BELOW | 250 |
| Gas Lift Flowlines | 3 | 8IN AND BELOW | 500 |
| Water producers flowlines (GRE) | 3 | 8IN AND BELOW | 500 |

9. THE MINIMUM DISTANCE FOR HORIZONTAL SEPARATION IS MEASURED FROM OD TO OD OF THE PIPELINES.
10. OIL AND GAS PRODUCTION AND INJECTION PIPELINES (HEADERS, TRANSFERLINES, TRUNKLINES, EXPORT LINES AND MOLS) SHALL BE CONSTRUCTED IN SEPARATE TRENCHES.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 03 | 25/07/2018 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 02 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 01 | 30/12/2014 | DSE | MAM | MA | ISSUED AS AGCD STANDARD PACKAGE |

SCALE: NTS | LOCATION: GENERAL | PROJECT No. P9100.3

CONSULTANT / ~~CONTRACTOR / VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL PIPELINE TRENCH DETAILS

أدنوك البرية ADNOC Onshore

DRG No. 30 99 22 0006 03 12/17

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P9100.3-30-99-22-0006-12.DWG

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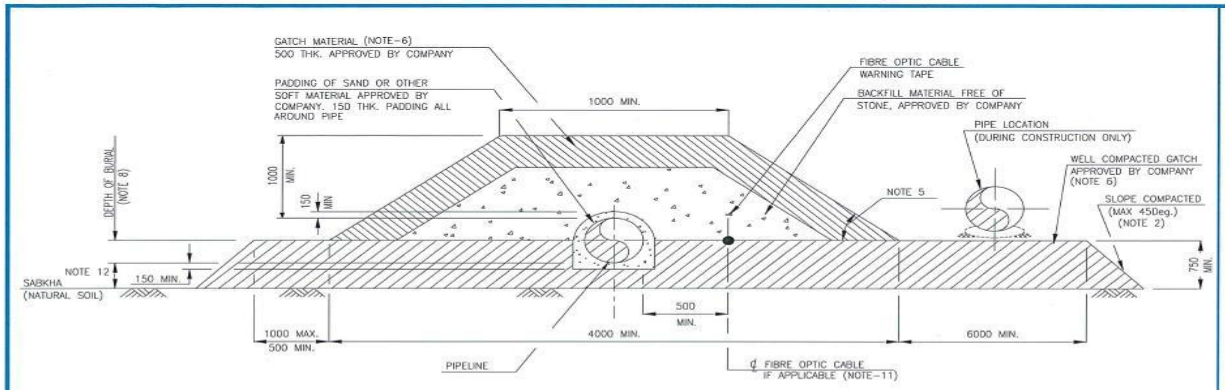
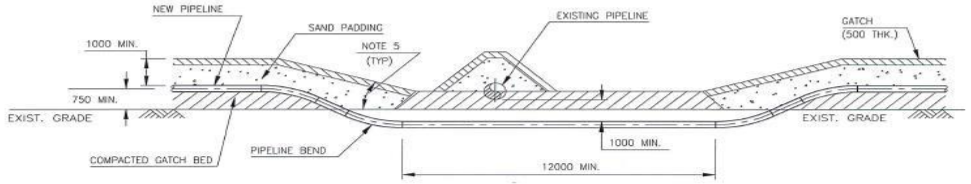



SABKHA AREA CONSTRUCTION
TYPICAL SECTION
RELATIVELY DRY SABKHA AREA




SABKHA AREA CONSTRUCTION
TYPICAL SECTION
EXISITING PIPELINE CROSSING

## NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. SLOPE OF FILL SHALL BE BASED ON ANGLE OF REPOSE OF FILL MATERIAL TO ENSURE STABLE SLOPE. DIMENSION SHALL BE CALCULATED BASED ON THE SLOPE OF FILL.
3. FILL MATERIAL SHALL BE APPLIED IN LAYERS AS PER PROJECT SPECIFICATION.
4. AT THE TIME OF HANDING OVER TO COMPANY, CONDITION OF ROW SHALL BE AS INDICATED IN THE DRAWING.
5. BERM ANGLE TO BE A MAXIMUM OF 45°.
6. GATCH MATERIAL TO BE USED SHALL MEET THE REQUIREMENTS OF SPECIFICATIONS INCLUDED IN ES 30-99-75-0042.
7. COMPACTION REQUIREMENTS SHALL BE IN ACCORDANCE WITH ES 30-99-75-0042. "SITE PREPARATION & EARTH WORKS.
8. MAXIMUM DEPTH OF BURIAL SHALL BE EQUAL TO HALF O.D. OF PIPE OR LESSER.
9. MINIMUM HEIGHT OF THE BERM SHALL BE 1000MM OR AS PER UPHEAVAL BUCKLING CALCULATIONS/RECOMMENDATIONS, WHICHEVER IS HIGHER.
10. IN CASE OF MULTIPLE PIPELINES INSTALLATION, THE OUTSIDE DISTANCE BETWEEN TWO PIPELINES SHALL BE MIN. 500 MM (FROM OD TO OD). REFER TO PIPELINE BASIS OF DESIGN (UNDERGROUND PIPELINE SYSTEMS) ES 30-99-12-0032.
11. IN CASE NO FIBRE OPTIC CABLE, 500 MM MIN. CLEARANCE SHOWN SHALL NOT BE APPLICABLE.
12. PIPELINE SIZES > 20" NPS, MINIMUM HEIGHT OF COMPACTION SHALL BE 1000 MM; AS SPECIFIED IN SPECIFICATION FOR UNDERGROUND PIPELINE CONSTRUCTION ES 30-99-12-0028.
13. "DRY SABKHA" IS REFERED TO THE NATURE OF TERRAIN WHERE THE GRAND WATER LEVEL IS ABOUT > 500MM FROM THE GRADE LEVEL ALL OVER THE TIME OF THE YEAR.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 0.3 | 25/07/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| 0.2 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 0.1 | 30/12/2014 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |

SCALE: NTS | LOCATION: GENERAL | PROJECT No. P9100.3

CONSULTANT / ~~CONTRACTOR / VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL DETAILS FOR CONSTRUCTION OF UNDERGROUND PIPELINES IN DRY SABKHA AREA

أدنوك البرية ADNOC Onshore

DRG No. 3.0 | 9.9 | 22 | 0.0.0.6 | 0.3 | 13/17
AREA | P/AREA | DOC CODE | SERIAL No. | REV. | SHT | OF | SHT

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P9100.3-30-99-22-0006-13.DWG

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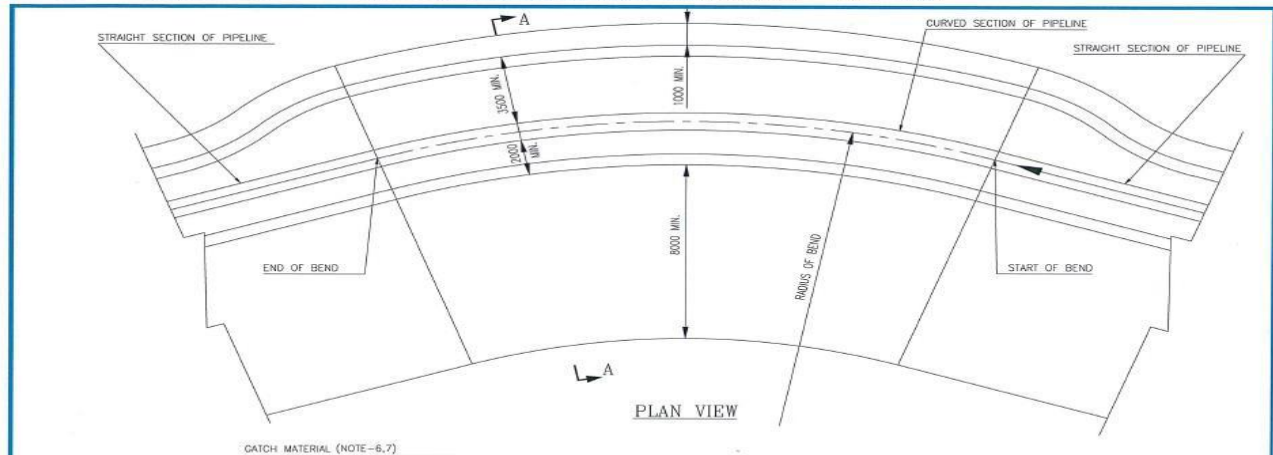
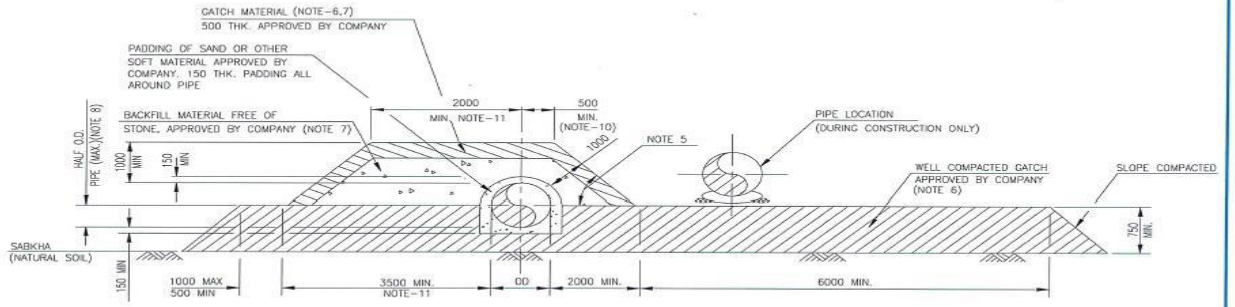



PLAN VIEW




VIEW A-A. TYPICAL SECTION FOR SABKHA AREA (DRY)

## NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. SLOPE OF FILL SHALL BE BASED ON ANGLE OF REPOSE OF FILL MATERIAL TO ENSURE STABLE SLOPE. DIMENSION SHALL BE CALCULATED BASED ON THE SLOPE OF FILL.
3. FILL MATERIAL SHALL BE APPLIED IN LAYERS AS PER PROJECT SPECIFICATION.
4. AT THE TIME OF HANDING OVER TO COMPANY, CONDITION OF ROW SHALL BE AS INDICATED IN THE DRAWING.
5. BERM ANGLE TO BE 45° MAXIMUM.
6. CATCH MATERIAL TO BE USED SHALL MEET THE REQUIREMENTS OF COMPANY SPECIFICATIONS NO. 30.99.75.0042. SITE PREPARATION AND EARTHWORKS.
7. COMPACTION REQUIREMENTS SHALL BE IN ACCORDANCE WITH ES 30-99-75-0042. "SITE PREPARATION & EARTH WORKS SPECIFICATION".
8. MAXIMUM DEPTH SHALL BE EQUAL TO HALF O.D. OF PIPE. HOWEVER FOR DEPTH OF PIPE IN WET SABKHA, REFER TO SH.17/17.
9. IN CASE OF FIBRE OPTIC CABLE TO BE LAID ALONG PIPELINE, IT SHALL BE AT A DISTANCE OF MIN. 500 MM FROM OUTSIDE DIA. OF PIPELINE.
10. FOR PIPELINE SIZES >24", DIMENSION SHALL BE INCREASED BY HALF O.D. OF PIPELINE.
11. ALLOWABLE SEPARATION DISTANCES FOR LATERAL BUCKLING OF SINGLE OR MULTIPLE PIPELINES (IN BOTH WET AND DRY SABKHA CONSTRUCTION) SHALL BE CALCULATED ON CASE BY CASE BASIS FOR EACH PIPELINE TAKING INTO CONSIDERATION OF PIPELINE'S SIZES, DESIGN AND OPERATING CONDITIONS, ACTUAL SOIL PARAMETERS AND NATURE OF SABKHA (DRY OR WET).

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 03 | 25/07/2018 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 02 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 01 | 30/12/2014 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |

SCALE: NTS | LOCATION: GENERAL | PROJECT No. P91003

CONSULTANT / ~~CONTRACTOR / VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL DETAILS FOR CONSTRUCTION OF UNDERGROUND PIPELINE IN SABKHA AREA NEAR BENDS

أدنوك البرية ADNOC Onshore

DRG No. 3.0 | 99 | 22 | 0006 | 03 | REV. | SHT 14 OF 17

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P91003-30-99-22-0006-14.DWG

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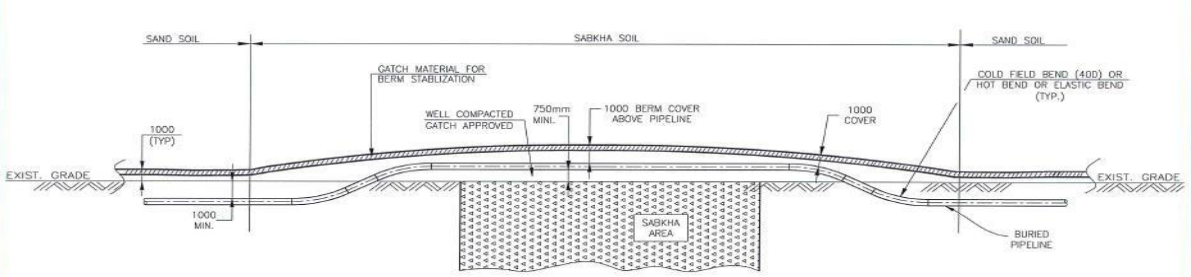


TYPICAL SECTION
(NOTE 3)

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. BERM ANGLE TO BE 45° MAXIMUM.
3. REFER SHEET 13 OF 17 FOR TYPICAL DETAILS FOR CONSTRUCTION OF UNDERGROUND PIPELINES IN SABKHA AREA.

| REV. | DATE | DRN | CHD | APD | DESCRIPTION |
|---|---|---|---|---|---|
| 03 | 25/07/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| 02 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 01 | 30/12/2014 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE. |

SCALE: N.T.S. | LOCATION: GENERAL | PROJECT No. P91003

CONSULTANT / CONTRACTOR / VENDOR: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL BERM DETAIL BURIED PIPELINE IN SAND / SABKHA AREA TERRAIN

أدنوك البرية ADNOC Onshore

DRG. No. 30 99 22 0006 03 15/17

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P91003-30-99-22-0006-15.DWG

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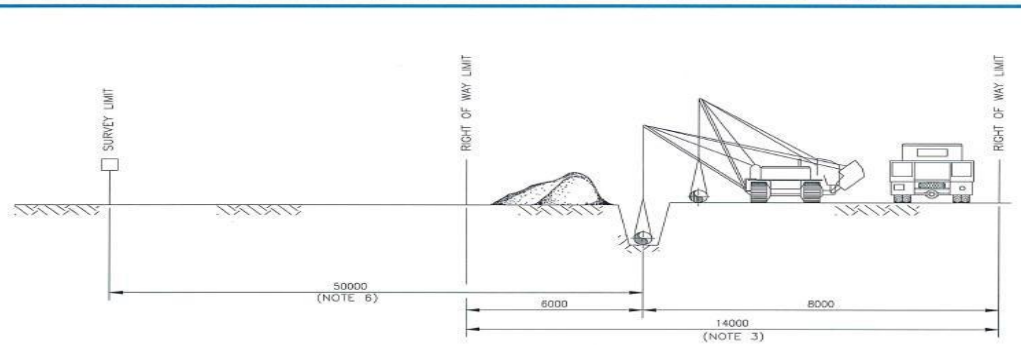
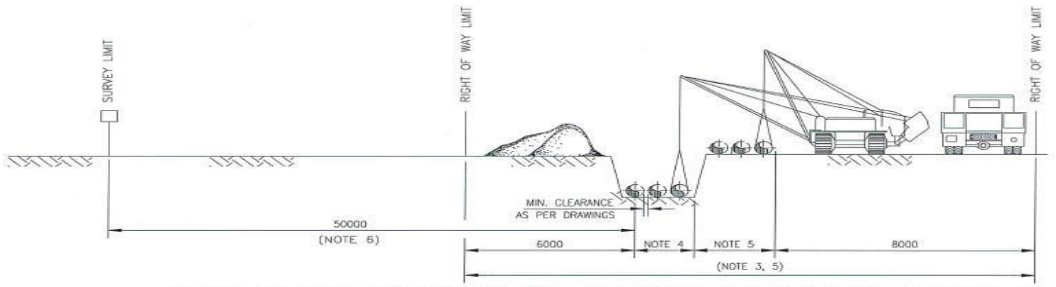



RIGHT OF WAY DIMENSIONS FOR SINGLE PIPELINE




RIGHT OF WAY DIMENSIONS FOR MULTIPLE PIPELINES IN COMMON TRENCH

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. CROSSING OR WORKING OVER FLOWLINES AND PIPELINES WITH HEAVY EQUIPMENTS ARE NOT PERMITTED, UNLESS SUITABLE PROTECTIONS ARE PROVIDED.
3. AT CERTAIN LOCATIONS ALONG THE PIPELINE ROUTE, RIGHT OF WAY DIMENSIONS MAY BE RESTRICTED TO LESS THAN SHOWN IN THIS DRAWING; SUBJECT TO SPECIFIC APPROVAL FROM ADNOC ONSHORE.
4. WIDTH OF TRENCH AS PER DETAIL DRAWING, REFER SHT. 12 OF 17.
5. DEPENDING ON THE NUMBER OF PIPELINES TO BE STRUNG, CONTRACTOR SHALL ALLOW FOR SUFFICIENT SPACE FOR ALL CONSTRUCTION ACTIVITIES AND FOR PERSONAL AS WELL AS EQUIPMENT ACCESS.
6. INDICATED DIMENSIONS IS SURVEY LIMIT ON ONE SIDE OF 50M WIDE SURVEY CORRIDOR. ACTUAL DIMENSION SHALL BE BASED ON TOTAL WIDTH OF CORRIDOR SPECIFIED IN TOPOGRAPHY S.O.W.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| Q3 | 25/07/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| Q2 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| Q1 | 30/12/2014 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |

SCALE: N.T.S | LOCATION: GENERAL | PROJECT No. P91003

FORM_ADNOC_Onshore_A3.dwg_(REV.1)

CONSULTANT / ~~CONTRACTOR / VENDOR~~:
ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL DETAIL RIGHT OF WAY (R.O.W) FOR PIPELINES

أدنوك البرية
ADNOC Onshore

DRG No. 30 99 22 00 06 03 16/17
AREA PCARDS DRG CODE SERIAL NO. REV. SHT OF SHT

P91003-30-99-22-0006-16.DWG

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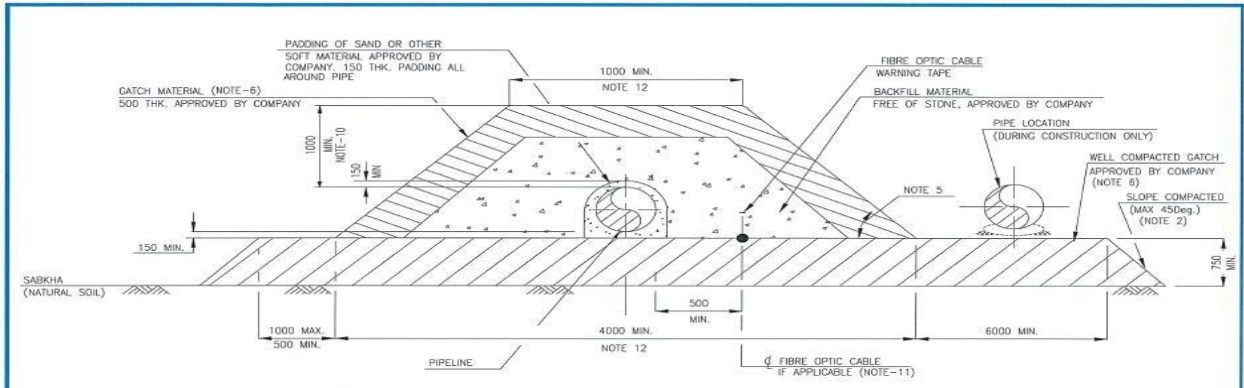
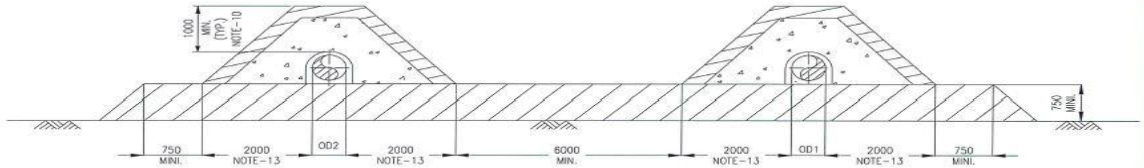



SABKHA AREA CONSTRUCTION
TYPICAL SECTION – 1
RELATIVELY WET SABKHA AREA
NOTE 8




SABKHA AREA CONSTRUCTION
TYPICAL SECTION – 2
PIPELINES SIZE 12IN AND ABOVE
NOTE 8

## NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. SLOPE OF FILL SHALL BE BASED ON ANGLE OF REPOSE OF FILL MATERIAL TO ENSURE STABLE SLOPE. DIMENSION SHALL BE CALCULATED BASED ON THE SLOPE OF FILL.
3. FILL MATERIAL SHALL BE APPLIED IN LAYERS AS PER PROJECT SPECIFICATION.
4. AT THE TIME OF HANDING OVER TO COMPANY, CONDITION OF ROW SHALL BE AS INDICATED IN THE DRAWING.
5. BERM ANGLE TO BE 45° MAXIMUM.
6. GATCH MATERIAL TO BE USED SHALL MEET THE REQUIREMENTS OF SPECIFICATIONS INCLUDED IN ES 30-99-75-0042.
7. COMPACTION REQUIREMENTS SHALL BE IN ACCORDANCE WITH ES 30-99-75-0042. "SITE PREPARATION & EARTH WORKS SPECIFICATION".
8. MULTIPLE PIPELINES FOR SIZES <10IN TO BE CONSTRUCTED AS PER TYPICAL SECTION-1. FOR PIPELINES SIZE 12IN AND ABOVE INCLUDING MOLs TO BE CONSTRUCTED AS PER TYPICAL SECTION – 2.
9. IN CASE OF MULTIPLE PIPELINES INSTALLATION, (TYPICAL SECTION-1) THE OUTSIDE DISTANCE BETWEEN TWO PIPELINES SHALL BE MIN. 500 MM (FROM OD TO OD). REFER TO PIPELINE BASIS OF DESIGN (UNDERGROUND PIPELINE SYSTEMS) ES 30-99-12-0032
10. MINIMUM HEIGHT OF THE BERM SHALL BE 1000MM OR AS PER UPHEAVAL BUCKLING CALCULATIONS/RECOMMENDATIONS, WHICHEVER IS HIGHER.
11. IN CASE NO FIBRE OPTIC CABLE, 500 MM MIN. CLEARANCE SHOWN SHALL NOT BE APPLICABLE.
12. WIDTH OF BERM SHALL BE BASED ON THE NUMBER OF PIPELINES AND THEIR SIZES AS PER PIPELINE BASIS OF DESIGN (UNDERGROUND PIPELINES SYSTEMS) ES 30-99-12-0032.
13. DISTANCE COULD BE CHANGED DURING THE PIPELINE ROUTE TURNS (REFER TO DWG 30-99-22-0006 SH 15 OF 17) IN ACCORDANCE WITH LATERAL BUCKLING CALCULATIONS.
14. "WET SABKHA" IS MAINLY REFERED TO THE NATURE OF TERRAIN WHERE WATER TABLE (GROUND WATER) IS VERY CLOSE TO THE SURFACE AND/OR APPEARS ON THE NATURAL GRADE LEVEL DURING WINTER SEASONS, SUCH AS (FUJAIRAH, NEB, RA, NORTH BAB, AND JD).

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 02 | 25/07/2018 | SSA | AAM | AS | RE-ISSUED FOR IMPLEMENTATION |
| 01 | 15/10/2017 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |

SCALE: N.T.S | LOCATION: GENERAL | PROJECT No. P91003

CONSULTANT /~~CONTRACTOR / VENDOR~~
ADNOC Onshore –TECHNICAL CENTRE ENGINEERING
DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE
DRG. TITLE: TYPICAL DETAILS FOR CONSTRUCTION OF UNDERGROUND PIPELINES IN WET SABKHA AREA

أدنوك البرية
ADNOC Onshore
DRG No. 30 99 22 0006 02 17/17

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P91003-30-99-22-0006-17.DWG

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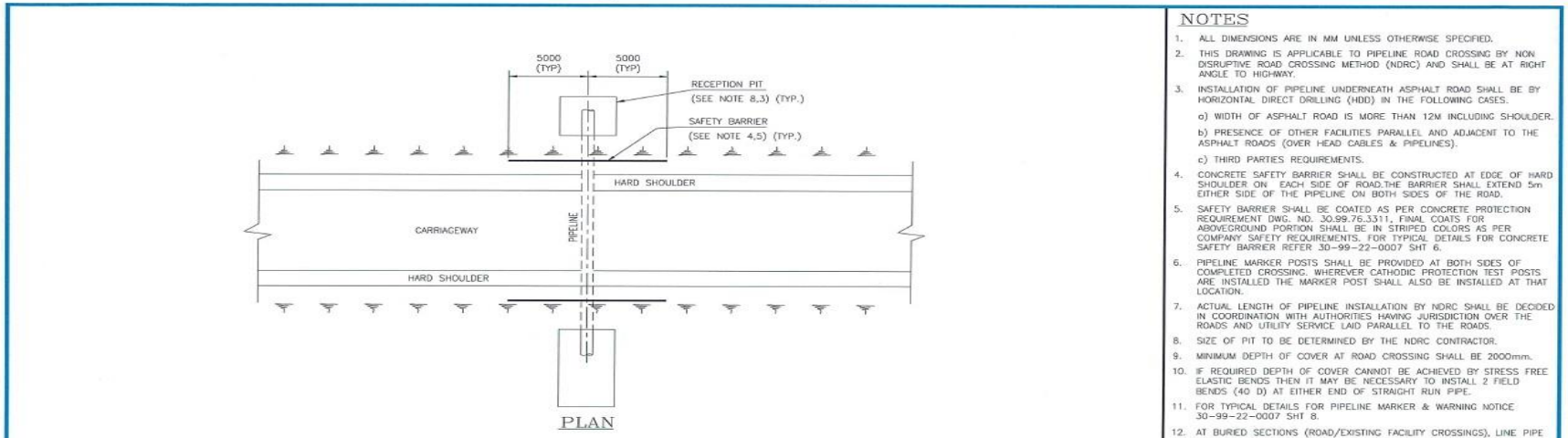


NOTES

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. THIS DRAWING IS APPLICABLE TO PIPELINE ROAD CROSSING BY NON DISRUPTIVE ROAD CROSSING METHOD (NDRC) AND SHALL BE AT RIGHT ANGLE TO HIGHWAY.
3. INSTALLATION OF PIPELINE UNDERNEATH ASPHALT ROAD SHALL BE BY HORIZONTAL DIRECT DRILLING (HDD) IN THE FOLLOWING CASES.
   a) WIDTH OF ASPHALT ROAD IS MORE THAN 12M INCLUDING SHOULDER.
   b) PRESENCE OF OTHER FACILITIES PARALLEL AND ADJACENT TO THE ASPHALT ROADS (OVER HEAD CABLES & PIPELINES).
   c) THIRD PARTIES REQUIREMENTS.
4. CONCRETE SAFETY BARRIER SHALL BE CONSTRUCTED AT EDGE OF HARD SHOULDER ON EACH SIDE OF ROAD.THE BARRIER SHALL EXTEND 5m EITHER SIDE OF THE PIPELINE ON BOTH SIDES OF THE ROAD.
5. SAFETY BARRIER SHALL BE COATED AS PER CONCRETE PROTECTION REQUIREMENT DWG. NO. 30.99.76.3311. FINAL COATS FOR ABOVEGROUND PORTION SHALL BE IN STRIPED COLORS AS PER COMPANY SAFETY REQUIREMENTS. FOR TYPICAL DETAILS FOR CONCRETE SAFETY BARRIER REFER 30-99-22-0007 SHT 6.
6. PIPELINE MARKER POSTS SHALL BE PROVIDED AT BOTH SIDES OF COMPLETED CROSSING. WHEREVER CATHODIC PROTECTION TEST POSTS ARE INSTALLED THE MARKER POST SHALL ALSO BE INSTALLED AT THAT LOCATION.
7. ACTUAL LENGTH OF PIPELINE INSTALLATION BY NDRC SHALL BE DECIDED IN COORDINATION WITH AUTHORITIES HAVING JURISDICTION OVER THE ROADS AND UTILITY SERVICE LAID PARALLEL TO THE ROADS.
8. SIZE OF PIT TO BE DETERMINED BY THE NDRC CONTRACTOR.
9. MINIMUM DEPTH OF COVER AT ROAD CROSSING SHALL BE 2000mm.
10. IF REQUIRED DEPTH OF COVER CANNOT BE ACHIEVED BY STRESS FREE ELASTIC BENDS THEN IT MAY BE NECESSARY TO INSTALL 2 FIELD BENDS (40 D) AT EITHER END OF STRAIGHT RUN PIPE.
11. FOR TYPICAL DETAILS FOR PIPELINE MARKER & WARNING NOTICE 30-99-22-0007 SHT 8.
12. AT BURIED SECTIONS (ROAD/EXISTING FACILITY CROSSINGS), LINE PIPE SHALL BE EXTERNALLY COATED BY 3LPE/3LPP/FBE (AS APPLICABLE) IN ACCORDANCE WITH ES 30-99-37-0017, & CATHODIC PROTECTION SHALL BE IN ACCORDANCE WITH EP 30-99-90-0279.
13. FOR ABOVE GROUND FLOWLINE CONFIGURATION AT ROAD/TRACKS/FLOWLINE CROSSING, REFER TO 30-99-22-0007, SHT. 4.
14. EXTENT OF HIGHER WALL THICKNESS PIPE AT CROSSING LOCATIONS SHALL BE AS INDICATED IN ALIGNMENT SHEETS.
15. EXTEND OF EXTERNAL COATING SHALL BE AS SPECIFIED PER DOC.NO 30-99-90-0279.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 2 | 25/07/18 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 1 | 05/02/15 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |
| A | 30/12/14 | DSE | MAM | MA | FIRST ISSUE |

SCALE: N.T.S. | LOCATION: GENERAL | PROJECT No. P91003

CONSULTANT / ~~CONTRACTOR / VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. -

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL ASPHALT ROAD CROSSING DETAIL FOR ABOVE GROUND FLOWLINES

أدنوك البرية ADNOC Onshore

DRG No. 30 99 22 0007 2 1/12

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P91003-30-99-22-0007-1.DWG

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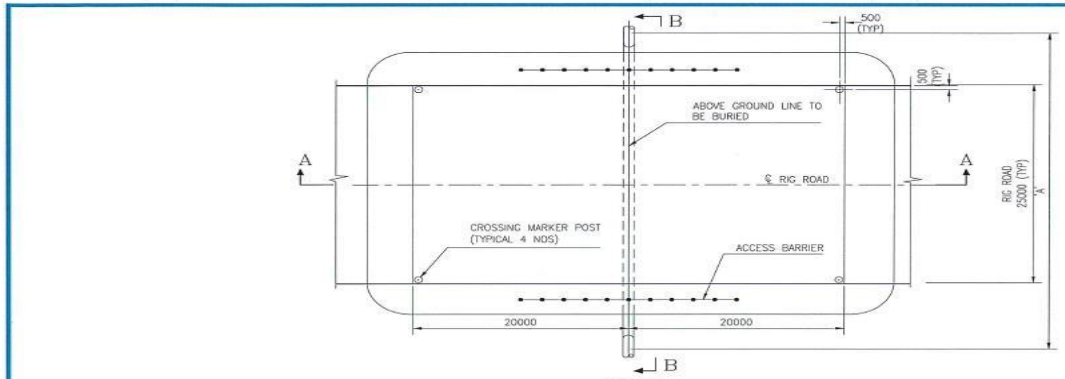


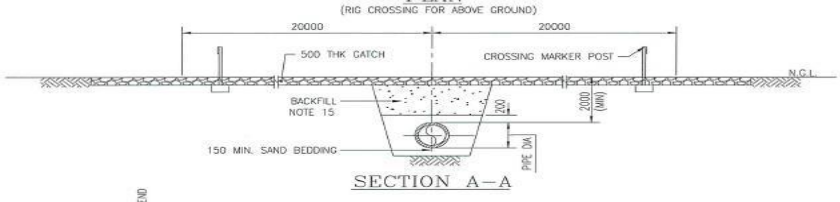


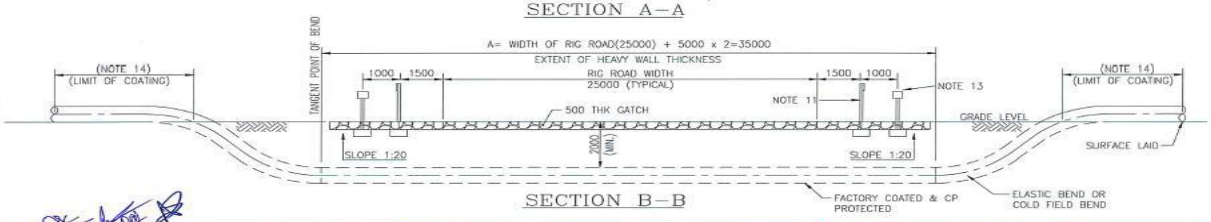


## NOTES

1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE SPECIFIED.
2. WORK ON ALL TRENCHED CROSSINGS FROM EXCAVATION TO RESTORATION OF RIG SURFACE SHALL BE SCHEDULED TO MINIMIZE INTERRUPTION OF TRAFFIC (CONSTRUCTION SHALL BE SCHEDULED IN LINE WITH FIELD SERVICE APPROVAL).
3. EXACT EDGE OF UNPAVED RIG ROAD CROSSINGS SHALL BE CONFIRMED IN THE FIELD.
4. CROSSING SHALL CONFORM TO REQUIREMENTS OF API RP 1102 AND PROJECT PIPELINE DESIGN BASIS.
5. BEDDING AND PADDING SHALL BE SOFT SAND MATERIAL COMPLYING WITH SPECIFICATION FOR UNDERGROUND PIPELINE CONSTRUCTION ES 30-99-12-0028.
6. ALL PADDING AND BACKFILL MATERIALS UNDER ROAD SHALL BE AS PER ADNOC Onshore SPECIFICATION 30-99-75-0042 SITE PREPARATION AND EARTHWORKS.
7. THE BOTTOM OF THE TRENCH SHALL BE PREPARED TO PROVIDE THE PIPE WITH UNIFORM BEDDING THROUGHOUT THE LENGTH OF THE CROSSING. BACKFILL SHALL BE COMPACTED WITHOUT AFFECTING PIPELINE INTEGRITY.
8. THE EXCAVATED ROAD SURFACE SHALL BE RESTORED TO ORIGINAL CONDITION WITH SIMILAR MATERIALS TO THE SATISFACTION OF RELEVANT AUTHORITIES.
9. THE ANGLE OF INTERSECTION BETWEEN THE PIPELINE CROSSING AND THE ROAD TO BE CROSSED SHALL BE AS CLOSE AS TO 90 DEGREES AS PRACTICABLE. IN NO CASE THE CROSSING ANGLE SHALL BE LESS THAN 60 DEGREES.
10. EXTENT OF HIGHER WALL THICKNESS PIPE INDICATED AT CROSSING LOCATIONS IS MINIMUM AND IT SHALL BE AS PER ALIGNMENT SHEETS.
11. FOR TYPICAL DETAILS OF ACCESS BARRIER REFER TO DRAWING No. 30-99-22-0007 SHT 7.
12. AT BURIED SECTIONS (ROAD/EXISTING FACILITY CROSSINGS), LINE PIPE SHALL BE COATED IN ACCORDANCE WITH ES 30-99-37-0017 & CATHODIC PROTECTION SHALL BE IN ACCORDANCE WITH EP 30-99-90-0279.
13. FOR MARKER POST TYPE-1, REFER TO DWG. No. 30-99-22-0007 SHT 8 TYPICAL PIPELINE MARKER POST & WARNING NOTICE.
14. EXTEND OF EXTERNAL COATING SHALL BE AS SPECIFIED PER DOC. NO 30-99-90-0279.
15. BACKFILL SHALL BE FREE FROM ROCKS, SHARP OBJECTS AND FORIGEN MATERIALS.

| REV. | DATE | DR'N | CH'D | APP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 2 | 25/07/18 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 1 | 05/02/15 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |
| A | 09/09/14 | DSE | MAM | MA | FIRST ISSUE |

SCALE: N.T.S | LOCATION: GENERAL | PROJECT No. P9I003

CONSULTANT / ~~CONTRACTOR~~ / ~~VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL RIG CROSSING DETAIL FOR ABOVE GROUND FLOWLINES

ADNOC Onshore

ORG. No. 30 99 22 0007 2 1 2/12

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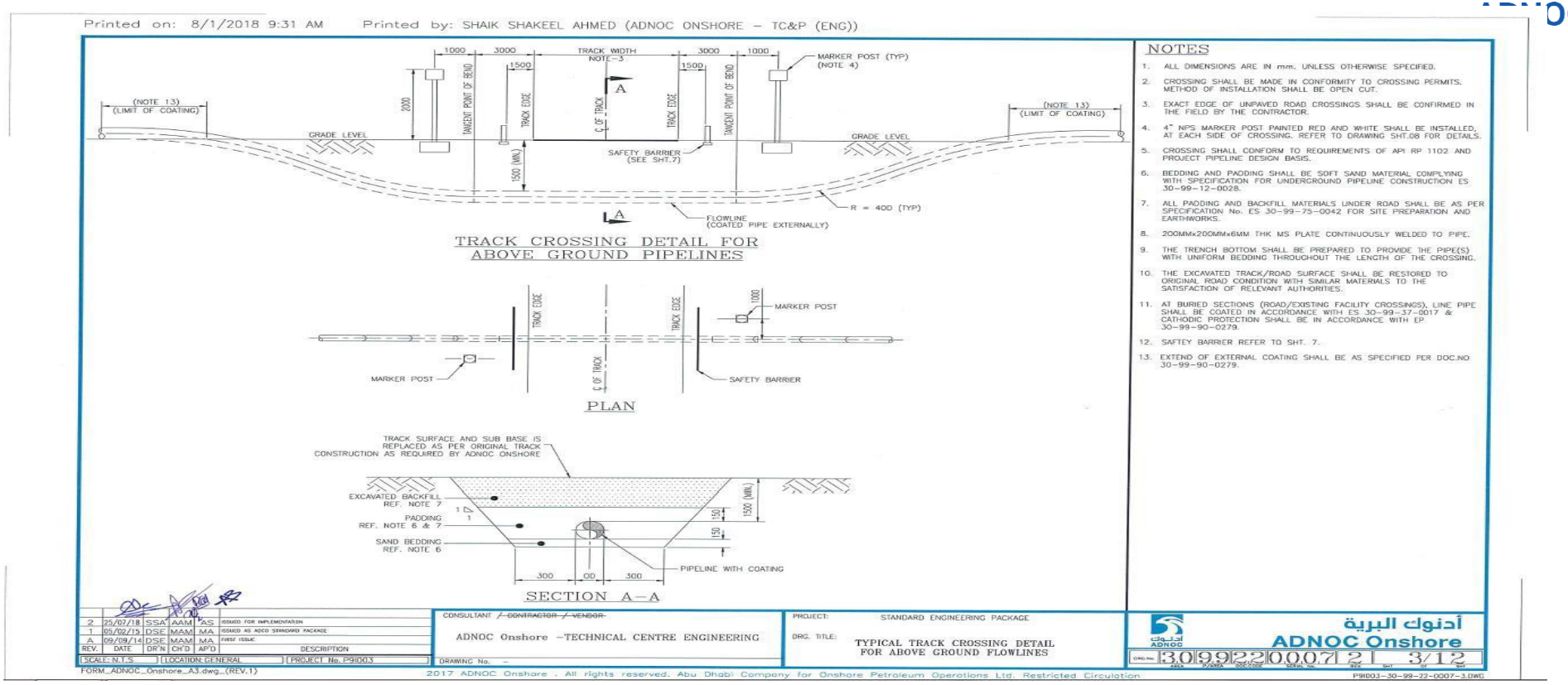
P9I003-30-99-22-0007-2.DWG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TRACK CROSSING DETAIL FOR ABOVE GROUND PIPELINES
PLAN
SECTION A–A
NOTES
1. ALL DIMENSIONS ARE IN mm, UNLESS OTHERWISE SPECIFIED.
2. CROSSING SHALL BE MADE IN CONFORMITY TO CROSSING PERMITS. METHOD OF INSTALLATION SHALL BE OPEN CUT.
3. EXACT EDGE OF UNPAVED ROAD CROSSINGS SHALL BE CONFIRMED IN THE FIELD BY THE CONTRACTOR.
4. 4" NPS MARKER POST PAINTED RED AND WHITE SHALL BE INSTALLED, AT EACH SIDE OF CROSSING. REFER TO DRAWING SHT.08 FOR DETAILS.
5. CROSSING SHALL CONFORM TO REQUIREMENTS OF API RP 1102 AND PROJECT PIPELINE DESIGN BASIS.
6. BEDDING AND PADDING SHALL BE SOFT SAND MATERIAL COMPLYING WITH SPECIFICATION FOR UNDERGROUND PIPELINE CONSTRUCTION ES 30-99-12-0028.
7. ALL PADDING AND BACKFILL MATERIALS UNDER ROAD SHALL BE AS PER SPECIFICATION No. ES 30-99-75-0042 FOR SITE PREPARATION AND EARTHWORKS.
8. 200MM×200MM×6MM THK MS PLATE CONTINUOUSLY WELDED TO PIPE.
9. THE TRENCH BOTTOM SHALL BE PREPARED TO PROVIDE THE PIPE(S) WITH UNIFORM BEDDING THROUGHOUT THE LENGTH OF THE CROSSING.
10. THE EXCAVATED TRACK/ROAD SURFACE SHALL BE RESTORED TO ORIGINAL ROAD CONDITION WITH SIMILAR MATERIALS TO THE SATISFACTION OF RELEVANT AUTHORITIES.
11. AT BURIED SECTIONS (ROAD/EXISTING FACILITY CROSSINGS), LINE PIPE SHALL BE COATED IN ACCORDANCE WITH ES 30-99-37-0017 & CATHODIC PROTECTION SHALL BE IN ACCORDANCE WITH EP 30-99-90-0279.
12. SAFTEY BARRIER REFER TO SHT. 7.
13. EXTEND OF EXTERNAL COATING SHALL BE AS SPECIFIED PER DOC.NO 30-99-90-0279.
CONSULTANT / CONTRACTOR / VENDOR
ADNOC Onshore –TECHNICAL CENTRE ENGINEERING
PROJECT: STANDARD ENGINEERING PACKAGE
DRG. TITLE: TYPICAL TRACK CROSSING DETAIL FOR ABOVE GROUND FLOWLINES
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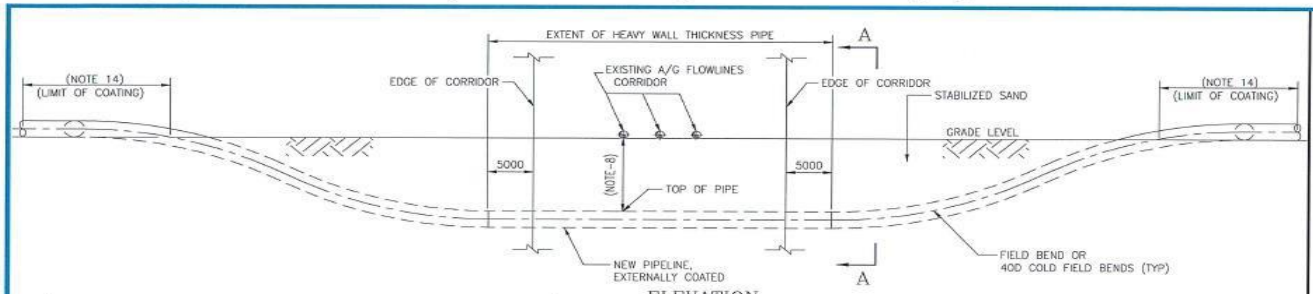


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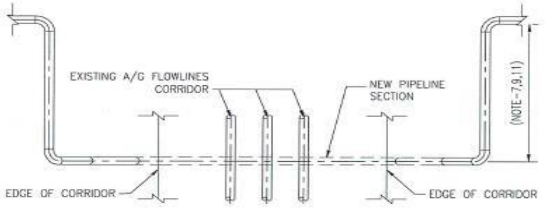
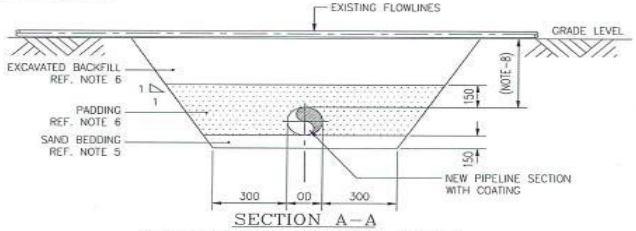
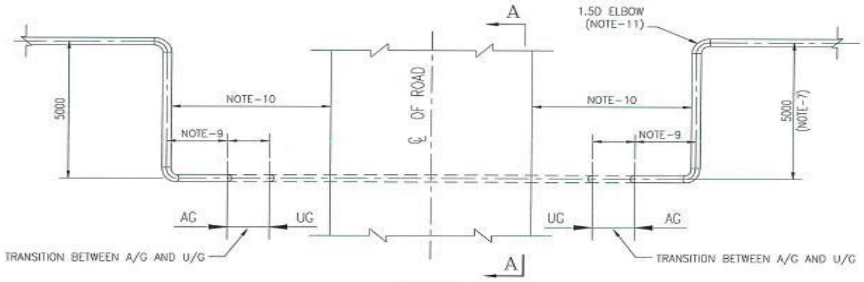



PLAN
CONFIGURATION AT FLOWLINE CORRIDOR CROSSING




SECTION A–A
TYPICAL PIPE TRENCH DETAIL




PLAN
CONFIGURATION AT ROAD CROSSING (NOTE-13)

## NOTES

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.
2. POSITION OF CROSSING IS INDICATED BY PERMANENT MARKER.
3. PIPELINE TO HAVE SMOOTH BEND OVER A LARGE DISTANCE TO AVOID ANY ADDITIONAL STRESS. MINIMUM ELASTIC BEND RADIUS SHALL BE AS PER MECHANICAL DESIGN CALCULATION.
4. AT BURIED SECTIONS (ROAD/EXISTING FACILITY CROSSINGS), LINE PIPE SHALL BE COATED IN ACCORDANCE WITH ES 30-99-37-0017 & CATHODIC PROTECTION SHALL BE IN ACCORDANCE WITH EP 30-99-90-0279.
5. BEDDING AND PADDING SHALL BE SOFT SAND MATERIAL COMPLYING WITH SPECIFICATION FOR UNDERGROUND PIPELINE CONSTRUCTION ES 30-99-12-0028.
6. ALL PADDING AND BACKFILL MATERIALS SHALL BE FREE FROM ROCKS, SHARP OBJECTS AND FORIGEN MATERIAL.
7. EXPANSION OFFSET LENGTH SHALL BE DEFINED/CONFIRMED BASED ON STRESS ANALYSIS AND FLOWLINE ROUTE CONFIGURATION.
8. THE DEPTH OF THE COVER SHALL BE AS FOLLOWS:

| LOCATION (CROSSING) | MINIMUM COVER (MM) |
|---|---|
| EXISTING FLOWLINE WITH ROW | 1500 & REFER TO 30-99-22-0007 (SHEET 02/12) |
| ROAD/TRACK | 1500 & REFER TO 30-99-22-0007 (SHEET 03/12) |
| ASPHALT | 2000 & REFER TO 30-99-22-0007 (SHEET 01/12) |
| RIG | 2000 |

9. LENGTH OF ABOVE GROUND EXPANSION LEG BEFORE A/G-U/G TRANSITION SHALL BE CONFIRMED BY STRESS ANALYSIS AND ACTUAL SITE CONDITIONS.
10. A MINIMUM CLEARANCE OF 50 METERS SHALL BE MAINTAINED BETWEEN THE EDGE OF THE ROAD AND THE FIRST FLOWLINE.
11. 1.5D OR 3D ELBOWS AT OFFSET CHANGE OF DIRECTION TO BE USED TO MINIMIZE SPACE REQUIRED, HOWEVER 40D COLD FIELD BEND MAY BE USED IF NO SPACE LIMITATIONS.
12. FOR MAIN FLOWLINE CORRIDORS WITH MIN. 100M WIDTH, NEW FLOWLINE CROSSING SHALL BE TRENCHLESS (REFER SHEET 01/12)
13. CROSSING CONFIGURATION SHOWN IS ALSO APPLICABLE TO FLOWLINE CROSSING TYPES AS PER 30-99-22-0007 SHT. 01/02/03.
14. EXTEND OF EXTERNAL COATING SHALL BE AS SPECIFIED PER DOC. NO. 30-99-90-0279.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 2 | 25/07/18 | SS | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 1 | 05/02/15 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |
| A | 09/09/14 | DSE | MAM | MA | FIRST ISSUE |

SCALE: N.T.S | LOCATION: GENERAL | PROJECT No. P91003

CONSULTANT ~~/ CONTRACTOR / VENDOR~~
ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL CONFIGURATION/DETAILS FOR NEW ABOVE GROUND FLOWLINE CROSSINGS WITH EXISTING ROADS/TRACKS & AG FLOWLINES

أدنوك البرية
ADNOC Onshore

DRG.No. 30 99 22 0007 2 | 4/12
AREA | PLANT/AREA | DOC.CODE | SERIAL No. | REV | SHT | OF | SHTS

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P91003-30-99-22-0007-4.DWG

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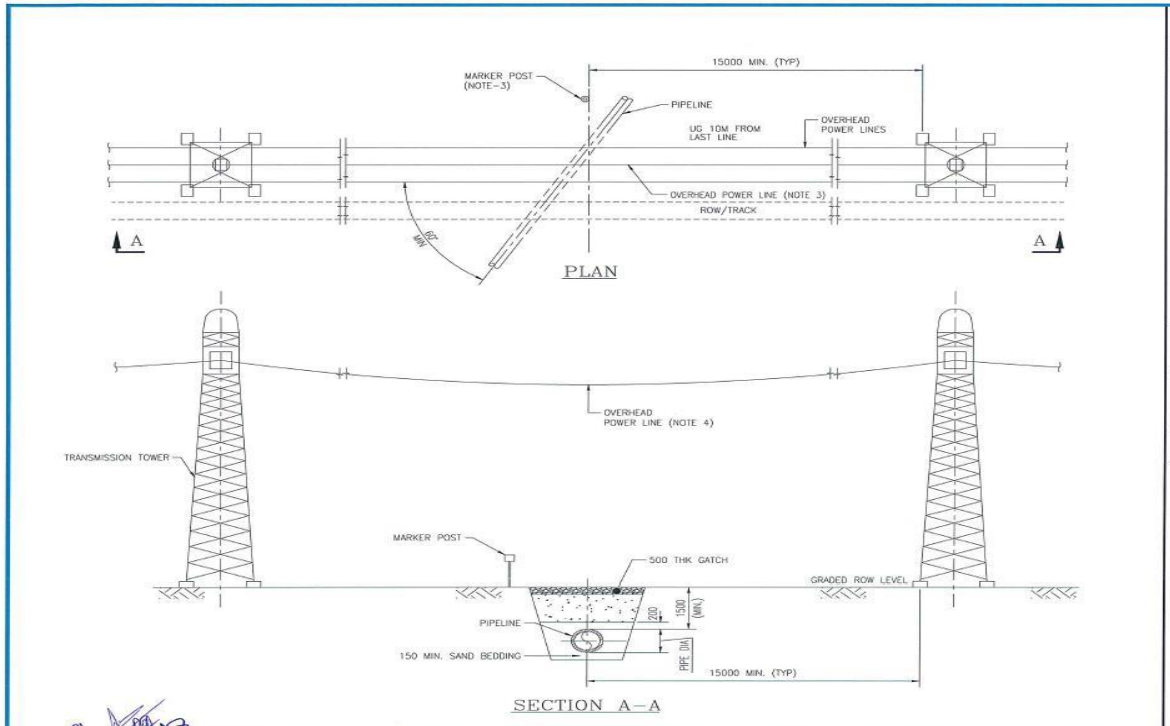


## NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. SUITABLE MEASURES SHALL BE TAKEN FOR THE PROTECTION OF THE LINE AND SECURITY OF PERSONNEL IN ACCORDANCE WITH PIPELINE CONSTRUCTION SPECIFICATION.
3. PERMANENT WARNING SIGNBOARDS SHALL BE INSTALLED ON THE PIPELINE RIGHT OF WAY ON EITHER SIDE OF THE OVERHEAD POWER LINE CROSSING.
4. CONTRACTOR SHALL CHECK MINIMUM GROUND CLEARANCE AT EACH OVERHEAD POWER LINE CROSSING SPAN. MEASUREMENT SHALL BE MADE TO LOWEST CONDUCTOR AT MAXIMUM TEMPERATURE IN STILL AIR. ANY SPAN NOT COMPLYING WITH THE REQUIREMENTS OF TABLE 1 SHALL BE REPORTED TO THE COMPANY.

TABLE – 1

| SYSTEM VOLTAGE (kv) | MINIMUM HEIGHT (m) |
|---|---|
| 11/33 | 12.50 |
| 132 | 13.50 |
| 220 | 14.00 |
| 440 | 16.00 |

5. THE ANGLE OF INTERSECTION BETWEEN THE PIPELINE CROSSING AND OVERHEAD POWER LINES SHALL BE AS CLOSE AS 90° AS PRACTICABLE. IN NO CASE, THE MIN. CROSSING ANGLE SHALL NOT BE LESS THAN 60°.
6. CONTRACTOR SHALL CARRY OUT DETAILED CATHODIC PROTECTION CALCULATIONS FOR EACH CROSSING AND ADOPT NECESSARY MITIGATION MEASURES FOR PROTECTING PIPELINE AND TO PREVENT INTERFERENCE WITH PIPELINE CP SYSTEM. ALL CALCULATIONS AND PROPOSED MITIGATION MEASURES SHALL BE APPROVED BY COMPANY.
7. THE PIPELINE AT THE CROSSING OF R.O.W OF OVERHEAD POWER LINES SHALL BE AS PER TRACK CROSSING DETAIL (REFER SHEETS 3).
8. AT BURIED SECTIONS (ROAD/EXISTING FACILITY CROSSINGS), LINE PIPE SHALL BE COATED IN ACCORDANCE WITH ES 30-99-37-0017 & CATHODIC PROTECTION SHALL BE IN ACCORDANCE WITH EP 30-99-90-0279.

| REV. | DATE | DRN | CHD | APD | DESCRIPTION |
|---|---|---|---|---|---|
| 2 | 25/07/18 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 1 | 05/02/15 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |
| A | 09/09/14 | DSE | MAM | MA | FIRST ISSUE |

SCALE: N.T.S | LOCATION: GENERAL | PROJECT No. P9100.3

FORM_ADNOC_Onshore_A3.dwg_(REV.1)

CONSULTANT / ~~CONTRACTOR / VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL OVERHEAD POWERLINE CROSSING DETAIL FOR ABOVE GROUND FLOWLINES

أدنوك البرية ADNOC Onshore

DRG. No. 3099220007 2 5/12

P9100-30-99-22-0007-5.DWG

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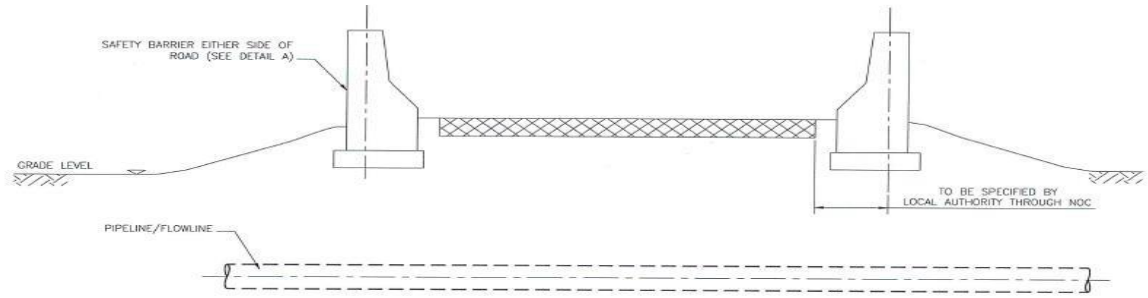
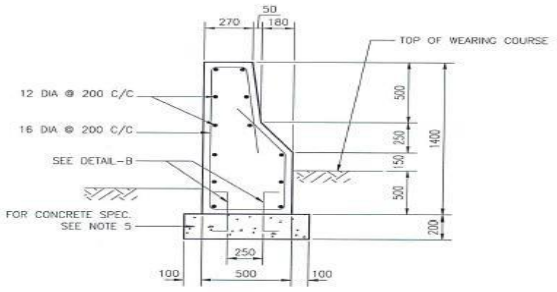
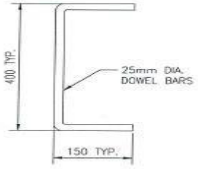



TYPICAL ROAD CROSSING CROSS–SECTION
(NOTE 2)




DETAIL–A
CONCRETE SAFETY BARRIER




DETAIL–B
TYPICAL DOWEL BAR TO BE PLACED AT EVERY 1000mm

NOTES

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. FOR TYPICAL DETAILS OF ROAD CROSSING REFER TO DRAWING No. 30–99–22–0007 SHT. 1
3. SAFETY BARRIERS SHALL BE COATED AS PER CONCRETE PROTECTION REQUIREMENT DWG. NO. 30–99–76–3311, FINAL COATING FOR ABOVE GROUND PORTION SHALL BE IN STRIPED COLOURS AS PER COMPANY SAFETY REQUIREMENT.
4. CONCRETE SAFETY BARRIERS ARE TO BE PROVIDED FOR A LENGTH SPECIFIED BY RELEVENT AUTHORITIES AND AS REQUIRED BY THE SITE CONDITIONS.
5. FOR GRADE OF CONCRETE AND REINFORCEMENT BAR, REFER TO DWG. NO. 30–99–76–3311.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 2 | 25/07/18 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 1 | 05/02/15 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |
| A | 09/09/14 | DSE | MAM | MA | FIRST ISSUE |

SCALE: N.T.S | LOCATION: GENERAL | PROJECT No. P9100.3

CONSULTANT / ~~CONTRACTOR~~ / ~~VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL CONCRETE SAFETY BARRIER DETAIL FOR ABOVE GROUND FLOWLINES

أدنوك البرية
ADNOC Onshore

DRG. No. 30 99 22 0007 2 6/12
ADNOC | AREA | DOC. TYPE | SERIAL No. | REV. | SHT. | OF | SHT.

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



P9100.3-30-99-22-0007-6.DWG

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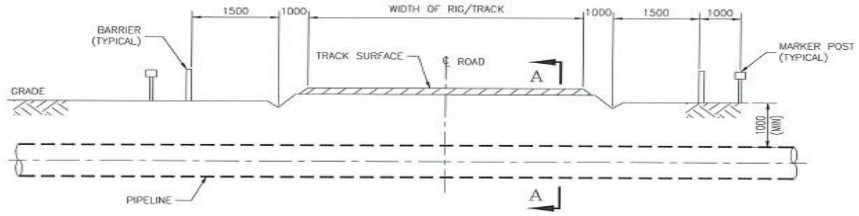
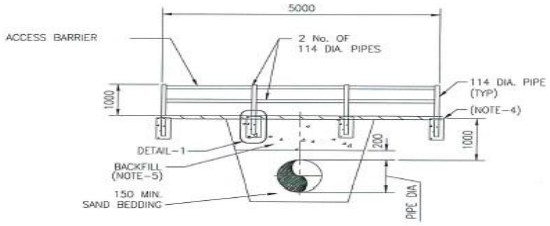
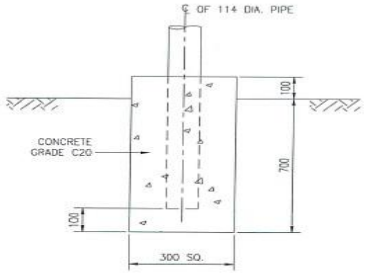



TYPICAL CROSS SECTION OF TRACK/RIG CROSSING
(NOTE 3)




SECTION A–A




DETAIL–1
TYPICAL FOUNDATION DETAIL

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. ACCESS BARRIERS SHALL BE GALVANIZED AND PAINTED AS PER SPECIFICATION No. ES 30-99-37-0013.
3. FOR TYPICAL DETAILS OF RIG/TRACK ROAD CROSSING REFER TO DRAWING No. 30-99-22-0007 SHT 2 & 3.
4. FOUNDATIONS SHALL BE PRECASTED IN SITE AS PER SPECIFICATION NO. 30-99-22-0007 Sheet 1/12 AND NO PRECASTED FOUNDATION SHALL BE ABOVE THE PIPELINE.
5. BACKFILL SHALL BE FREE FROM ROCKS, SHARP OBJECTS AND FORIGEN MATERIALS.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 2 | 25/07/18 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 1 | 05/02/15 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |
| A | 09/09/14 | DSE | MAM | MA | FIRST ISSUE |

SCALE: N.T.S | LOCATION: GENERAL | PROJECT No. P91003

CONSULTANT / ~~CONTRACTOR / VENDOR~~
ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL BARRIER DETAIL FOR TRACK / RIG CROSSING ACCESS

أدنوك البرية
ADNOC Onshore

DRG No. 30 99 22 0007 2 7/12

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P91003-30-99-22-0007-7.DWG

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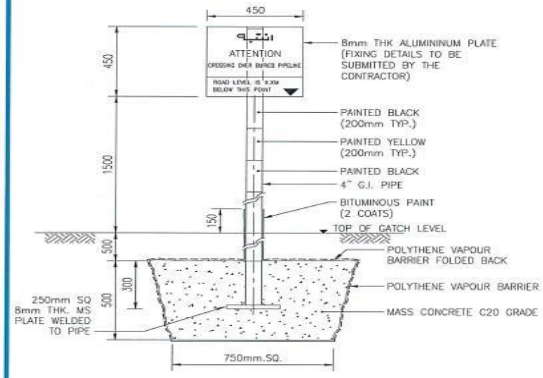
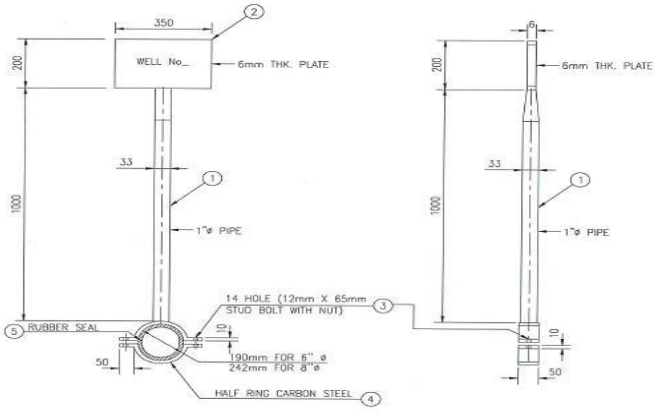



MARKER POST (TYPE–2)
FOR CROSSING




FRONT VIEW




SIDE VIEW

MARKER POST (TYPE–1)
KILOMETER CHAINAGE

## NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. MARKER POST (TYPE–1) SHALL BE INSTALLED AT EVERY ONE KILOMETER INTERVAL THROUGHOUT THE FLOWLINE ROUTE, MARKER POST (TYPE–2) AT ROAD CROSSINGS, AT CROSSINGS OF EXISTING PIPELINES, STATIONS APPROACH AND AT CHANGE OF HORIZONTAL DIRECTION.
3. PAINTING OF STEEL STRUCTURES AND SIGN POST SHALL BE AS PER SPECIFICATION No. ES 30–99–37–0013.
4. THE ABOVE GROUND SECTION OF PIPE FOR MARKER POST SHALL BE PAINTED WITH CORROSION RESISTANT PAINT WITH ALTERNATE BANDS OF RED AND WHITE COLOR.
5. MARKER POST (TYPE–2) SHALL BE INSTALLED AT CROSSING. REFER DWG. No. 30–99–22–0007 SHT. 1/2/3/5/7.

## MATERIALS FOR MARKER POST (TYPE–1)

| ITEM No | QTY. | DESCRIPTION |
|---|---|---|
| 1 | 1 MTR | 1" PIPE SEAMLESS, SCH.40, ASTM A106 B |
| 2 | 1 | CS–PLATE, 350mm X 200mm X 6mm Thick. |
| 3 | 2 | 12mm X 65mm LONG STUD BOLT & TWO NUTS |
| 4 | 2 | HALF RING.CARBON STEEL, 383mm X 50mm X 10mm Thick (FOR 6" FLOW LINE), 464mm X 50mm X 10mm Thick (FOR 8" FLOW LINE) |
| 5 | 1 | RUBBER SEAL TO CORROSION RESISTANCE 12MM X 70MM |

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 2 | 25/07/2018 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 1 | 05/02/15 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |
| A | 09/09/14 | DSE | MAM | MA | FIRST ISSUE |

SCALE: N.T.S | LOCATION: GENERAL | PROJECT No. P9I003

CONSULTANT / ~~CONTRACTOR / VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

ORG. TITLE: TYPICAL MARKER POST AND WARNING NOTICE DETAIL FOR ABOVE GROUND FLOWLINES

أدنوك البرية ADNOC Onshore

DRG No. 30 | 99 | 22 | 0007 | 2 | REV. 8/12

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P9I003-30-99-22-0007-8.DWG

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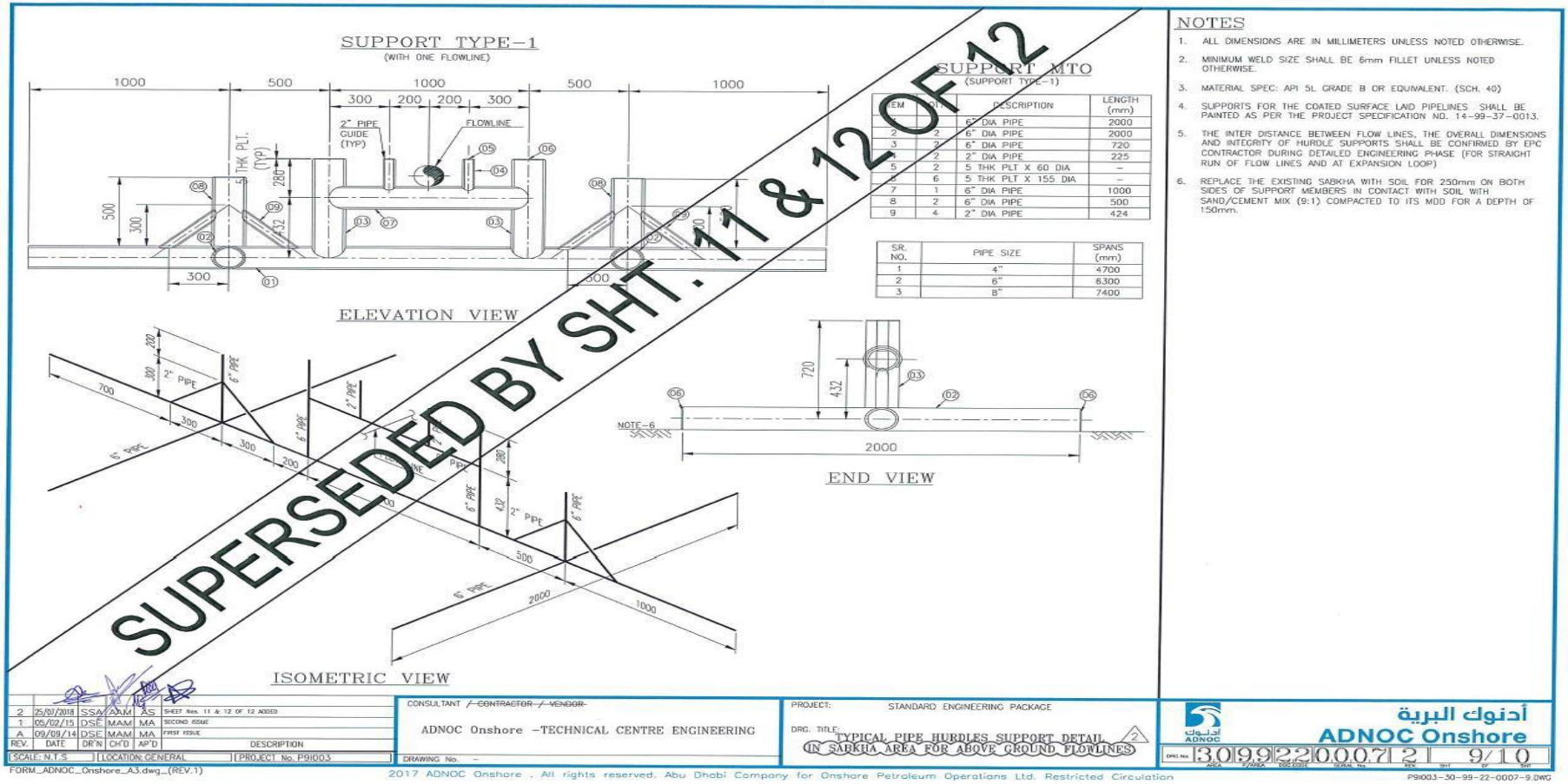


NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. MINIMUM WELD SIZE SHALL BE 6mm FILLET UNLESS NOTED OTHERWISE.
3. MATERIAL SPEC: API 5L GRADE B OR EQUIVALENT. (SCH. 40)
4. SUPPORTS FOR THE COATED SURFACE LAID PIPELINES SHALL BE PAINTED AS PER THE PROJECT SPECIFICATION NO. 14–99–37–0013.
5. THE INTER DISTANCE BETWEEN FLOW LINES, THE OVERALL DIMENSIONS AND INTEGRITY OF HURDLE SUPPORTS SHALL BE CONFIRMED BY EPC CONTRACTOR DURING DETAILED ENGINEERING PHASE (FOR STRAIGHT RUN OF FLOW LINES AND AT EXPANSION LOOP)
6. REPLACE THE EXISTING SABKHA WITH SOIL FOR 250mm ON BOTH SIDES OF SUPPORT MEMBERS IN CONTACT WITH SOIL WITH SAND/CEMENT MIX (9:1) COMPACTED TO ITS MDD FOR A DEPTH OF 150mm.

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 2 | 25/07/2018 | SSA | AAM | AS | SHEET Nos. 11 & 12 OF 12 ADDED |
| 1 | 05/02/15 | DSE | MAM | MA | SECOND ISSUE |
| A | 09/09/14 | DSE | MAM | MA | FIRST ISSUE |

SCALE: N.T.S | LOCATION: GENERAL | PROJECT No. P91003

CONSULTANT / ~~CONTRACTOR / VENDOR~~
ADNOC Onshore –TECHNICAL CENTRE ENGINEERING
DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE
DRG. TITLE: TYPICAL PIPE HURDLES SUPPORT DETAIL IN SABKHA AREA FOR ABOVE GROUND FLOWLINES

أدنوك البرية
ADNOC Onshore
DWG No. 30 99 22 0007 2 REV. 2 SHT. 9/10

FORM_ADNOC_Onshore_A3.dwg_(REV.1)



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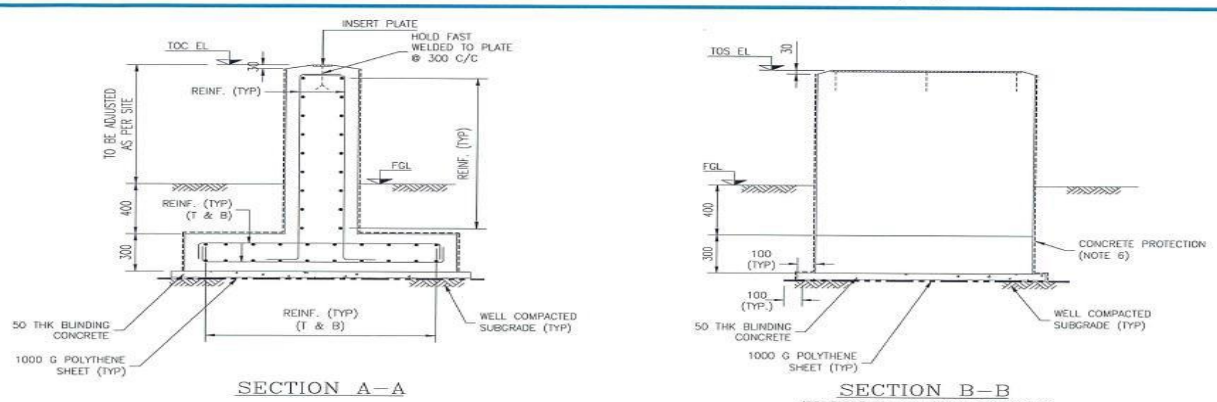
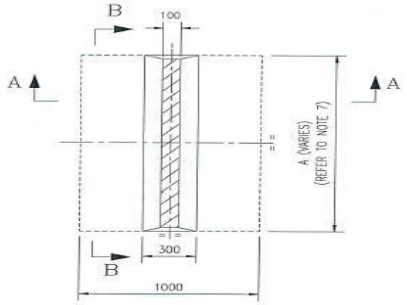



SECTION A–A




SECTION B–B
(REINFORCEMENT NOW SHOWN FOR CLARITY)




TYPICAL PLAN–PIPE SLEEVER

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS.
2. FOUNDATION SIZE AND REINFORCEMENT ARE INDICATIVE ONLY. CONSTRUCTION DRAWING TO BE DEVELOPED DURING DETAILED DESIGN BASED ON LATEST PIPING G.A DRAWINGS AND LOADS.
3. FOR ORIENTATION, LOCATION AND ELEVATION REFER PIPING ARRANGEMENT DRAWINGS.
4. THE PIPE SUPPORT SCHEDULE SHALL BE DEVELOPED AS PART OF DETAILED ENGINEERING.
5. FOR LEGEND & GENERAL NOTES REFER TO DWG NO. CIVIL GENERAL NOTES DRAWING.
6. SELF ADHESIVE MEMBRANE EQUIVALENT TO BITUTHENE 1200 OR PROOFEX GP (1.6mm THICK) SHALL BE USED FOR CONCRETE SURFACES IN SABKHA/ BELOW WATER TABLE AREAS. THE MEMBRANE SHALL BE APPLIED IN STRICT ACCORDANCE OF MANUFACTURER INSTRUCTIONS INCLUDING THE NECESSARY PRIMER. LAPS SHALL BE 300mm MINIMUM. THE MEMBRANE SHALL BE COVERED WITH A 3.5mm THICK BITUMEN IMPREGNATED FIBERBOARD OR 12mm THICK BITUMEN IMPREGNATED SOFT BOARD.
7. WIDTH OF SLEEPERS SHOWN ARE INDICATIVE ONLY. IT SHALL BE FINALIZED DURING DETAIL ENGINEERING.

| WIDTH OF SLEEPER (A) | |
|---|---|
| NO. OF PIPES SUPPORTED | WIDTH OF SLEEPER (mm) |
| 1 | 400 |
| 2 | 1100 |
| 3 | 1600 |
| 4 | 2100 |
| 5 | 2600 |
| 6 | 3100 |
| 7 | 3600 |
| 8 | 4100 |
| 9 | 4600 |
| 10 | 5100 |
| 12 | 6100 |

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 2 | 25/07/2018 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |
| 1 | 05/02/15 | DSE | MAM | MA | ISSUED AS ADCO STANDARD PACKAGE |
| A | 09/09/14 | DSE | MAM | MA | FIRST ISSUE |

SCALE: N.T.S | LOCATION: GENERAL | PROJECT No. P9100.3

CONSULTANT / ~~CONTRACTOR~~ / ~~VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL SLEEPER DETAILS IN SABKHA AREA FOR ABOVE GROUND FLOWLINES

أدنوك البرية ADNOC Onshore

DRG No. 3 0 9 9 2 2 0 0 0 7 2 | REV. 10/12

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PSI003-30-99-22-0007-10.DWG

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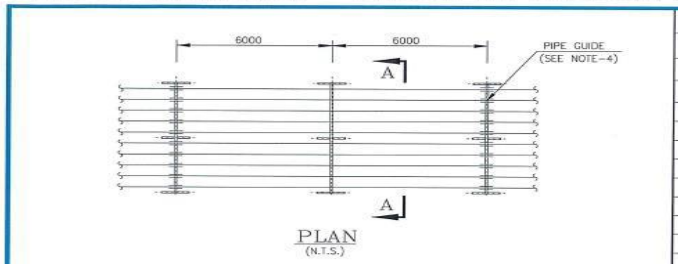
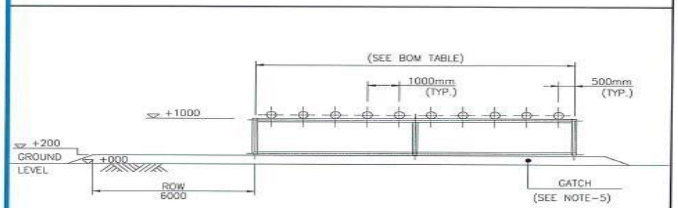
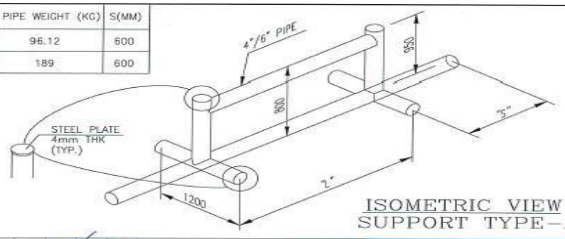



PLAN
(N.T.S.)




SECTION A–A
(N.T.S.)

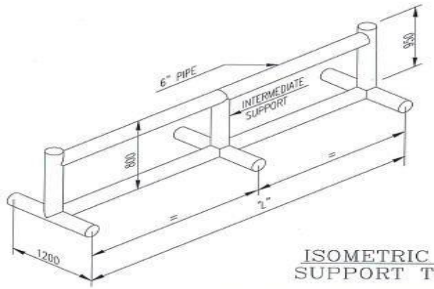
| SN. | SIZE | PIPE WEIGHT (KG) | S(MM) |
|---|---|---|---|
| 1 | 4" | 96.12 | 600 |
| 2 | 6" | 189 | 600 |



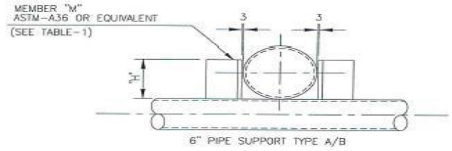

ISOMETRIC VIEW
SUPPORT TYPE–A

## BILL OF MATERIAL FOR SUPPORT TYPE "A" & "B"

| NO. OF FLOWLINES | L (M) | SIZE | DESCRIPTION | QUANTITY (M) | NO. OF STEEL PLATE | WEIGHT (Kg) | TYPE |
|---|---|---|---|---|---|---|---|
| 1 | 1.1 | 4" | PIPE, API 5L Gr.B, 6.0mm WALL THICKNESS | 6.5 | 6 | 104 | A |
| 1 | 1.1 | 6" | PIPE, API 5L Gr.B, 7.9mm WALL THICKNESS | 9.3 | 6 | 145 | A |
| 3 | 3 | 6" | – DITTO – | 10.3 | 6 | 322 | A |
| 4 | 4 | 6" | – DITTO – | 12.3 | 6 | 384 | A |
| 5 | 5 | 6" | – DITTO – | 14.3 | 6 | 447 | A |
| 6 | 6 | 6" | – DITTO – | 18.3 | 8 | 572 | B |
| 7 | 7 | 6" | – DITTO – | 20.3 | 8 | 634 | B |
| 8 | 8 | 6" | – DITTO – | 22.3 | 8 | 697 | B |
| 9 | 9 | 6" | – DITTO – | 24.3 | 8 | 759 | B |
| 10 | 10 | 6" | – DITTO – | 26.3 | 8 | 822 | B |




ISOMETRIC VIEW
SUPPORT TYPE–B



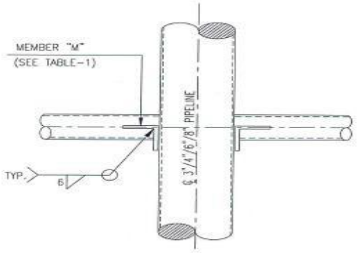

PIPE GUIDE – ELEVATION VIEW

## NOTES

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.
2. PROVIDE 3mm THICK LINER (HDPE OR EQUIVALENT) ON TOP MEMBER OF SUPPORT TO PREVENT DIRECT METAL-TO-METAL CONTACT BETWEEN FLOW LINE AND SUPPORT STEEL MEMBER.
3. PIPE SUPPORT TO BE PROVIDED EVERY 6 METERS.
4. PIPE GUIDE TO BE INSTALLED AT EVERY OTHER PIPE SUPPORT.
5. GATCH MATERIAL FOR STABILIZATION OF R.O.W. IS AS PER SPECIFICATION NO. ES 30-99-75-0042 SITE PREPARATION AND EARTH WORKS.
6. LENGTH OF PIPE SUPPORTS DEPENDS ON NUMBER OF PIPELINE (SEE BOM TABLE).
7. PAINTING OF PIPE SUPPORT AND FINISHED COLOR SHALL BE AS PER SPECIFICATION NO. ES 30-99-37-0013.

TABLE-1

| SN | NPS | MEMBER "M" | "H" |
|---|---|---|---|
| 1 | 3" | L 60X60X8 | 60 |
| 2 | 4" | L 60X60X8 | 80 |
| 3 | 6" | L 80X80X8 | 125 |
| 4 | 8" | L 80X80X8 | 150 |




PIPE GUIDE – PLAN VIEW

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 1 | 25/07/2018 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |

SCALE: N.T.S | LOCATION: GENERAL | PROJECT No. P91003

CONSULTANT / ~~CONTRACTOR / VENDOR~~: ADNOC Onshore –TECHNICAL CENTRE ENGINEERING

DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE

DRG. TITLE: TYPICAL MULTIPLE PIPELINE SUPPORTS OFF-PLOT ABOVE GROUND FLOWLINES – SABKHA AREA

أدنوك البرية
ADNOC Onshore

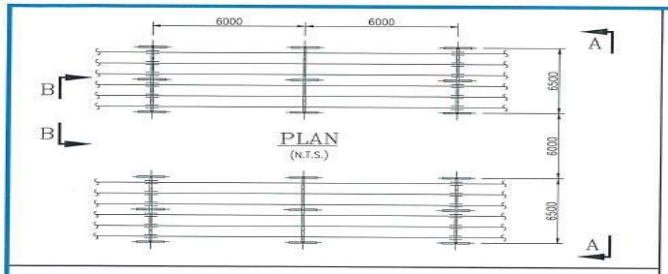
DRG. No. 30 | 99 | 22 | 0007 | 1 | 11/12
AREA | FUNCTION | DISCIPLINE | DOCUMENT TYPE | SERIAL NO. | REV | SHT | NO. OF SHTS

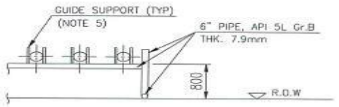
FORM_ADNOC_Onshore_A3.dwg_(REV.1)



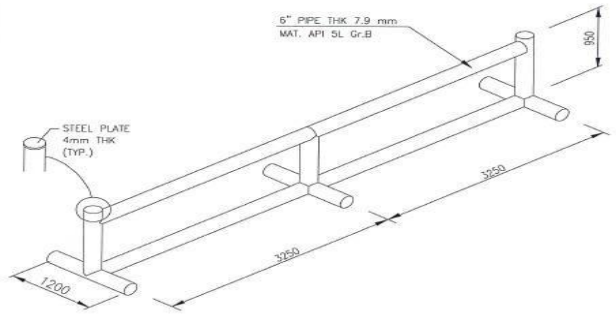
PS1003-30-99-22-0007-11.DWG

Printed on: 8/1/2018 9:30 AM Printed by: SHAIK SHAKEEL AHMED (ADNOC ONSHORE – TC&P (ENG))




SECTION B–B
(N.T.S.)



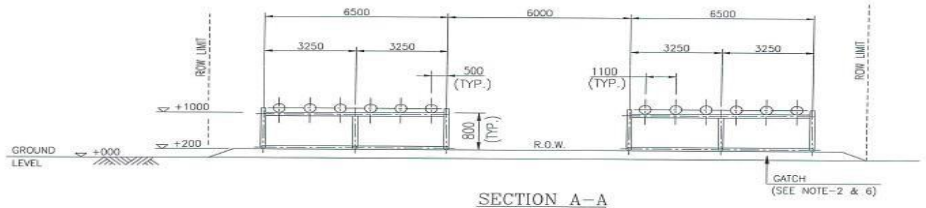

ISOMETRIC VIEW

BILL OF MATERIAL FOR 1 PIECE

| SIZE | DESCRIPTION | QUANTITY (m) | WEIGHT (kg) | NO. OF STEEL PLATE |
|---|---|---|---|---|
| 6" | PIPE, API 5L Gr.B, 7.9mm WALL THICKNESS | 19.30 | 603 | 8 |

NOTES

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.
2. RIGHT OF WAY OF THE FLOWLINE CORRIDOR IS GATCHED FOR A DISTANCE OF 200M FROM STATION FENCE. ALONG THIS PORTION OF RIGHT OF WAY THE FLOWLINES ARE SUPPORTED ABOVE GROUND.
3. PROVIDE 3mm THICK LINER (HDPE OR EQUIVALENT) ON TOP MEMBER OF SUPPORT TO PREVENT DIRECT METAL-TO-METAL CONTACT BETWEEN FLOW LINE AND SUPPORT STEEL MEMBER.
4. PIPE SUPPORT TO BE PROVIDED EVERY 6 METERS.
5. PIPE GUIDE TO BE INSTALLED AT EVERY OTHER PIPE SUPPORT. FOR GUIDE DETAIL SEE DWG. NO. 30-99-22-0007 SHEET 10.
6. GATCH MATERIAL FOR STABILIZATION OF R.O.W. IS AS PER SPECIFICATION NO. ES 30-99-75-0042 SITE PREPARATION AND EARTH WORKS.
7. PAINTING OF PIPE SUPPORT AND FINISHED COLOR SHALL BE AS PER SPECIFICATION NO. ES 30-99-37-0013.




SECTION A–A
(N.T.S.)

| REV. | DATE | DR'N | CH'D | AP'D | DESCRIPTION |
|---|---|---|---|---|---|
| 1 | 25/07/2018 | SSA | AAM | AS | ISSUED FOR IMPLEMENTATION |

SCALE: N.T.S | LOCATION: GENERAL | PROJECT No. P9100.3

FORM_ADNOC_Onshore_A3.dwg_(REV.1)

CONSULTANT / ~~CONTRACTOR~~ / ~~VENDOR~~
ADNOC Onshore –TECHNICAL CENTRE ENGINEERING
DRAWING No. –

PROJECT: STANDARD ENGINEERING PACKAGE
DRG. TITLE: TYPICAL FLOWLINE SUPPORTS (PIPE HURDLES) OFF-PLOT AT STATION APPROACH

أدنوك البرية
ADNOC Onshore
DRC No. 3 0 99 22 0007 1 1 12/12
AREA PLANT SEQ. NO. SERIAL No. REV. SHT TOT



P9100.3-30-99-22-0007-12.DWG