

Basic Engineering Study for Aung Sinkha Development Project Phase 1A

SPECIFICATION FOR SOIL RESISTIVITY SURVEY & TESTING

 PTT Exploration and Production Public Company Limited Aung Sinkha Development Project Phase 1A Basic Engineering	
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	Basic Engineering Study for Aung Sinkha Development Project Phase 1A		
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1. INTRODUCTION

1.1 Project Overview

PTTEP International Limited (PTTEPI) intends to develop and produce hydrocarbon from the offshore Block M3 named Aung Sinkha (ASK) field. The project is under Production Sharing Contract (PSC) with Myanmar Oil & Gas Enterprise (MOGE) signed on 7th August 2004 while the PSC effective date was on 1st November 2004.

PTTEPI as an Operator had performed 2,842 line-km of 2D seismic, 619 km² of 3D seismic, and drilled 11 Exploration and Appraisal wells. After successful exploration and appraisal drilling campaigns in 2015, PTTEPI completed the ASK Field Development Plan and submitted it to MOGE for approval. MOGE approved ASK Field Development Plan in April 2021.

The ASK field is located offshore in the Gulf of Moattama, Myanmar, as illustrated in Figure 1-1. The field is located approximately 70 km from Land Fall Point (LFP) at Daw Nyein village and 200 km south-west of Yangon with a water depth range of 15 - 25 meters.

The feed gas will be transported from two (2) offshore wellhead platforms through an offshore export pipeline to ASK Onshore Processing Facilities (APF) located in Daw Nyein village for processing. The sales gas after processing will be exported to the tie-in point at Gas Receiving Station no. 2 (GRS#2), of Domestic Gas to Power Pipeline Development Project, nearby the APF. The condensate will be kept in onshore storage tanks before loading, transporting/ offloading to customers. The design of the surface facilities will be based on a Contractual Daily Capacity (CDC) of 60 MMscfd with provision for future expansion to 100 MMscfd. The gas production is planned to start up by Q4 of 2025.

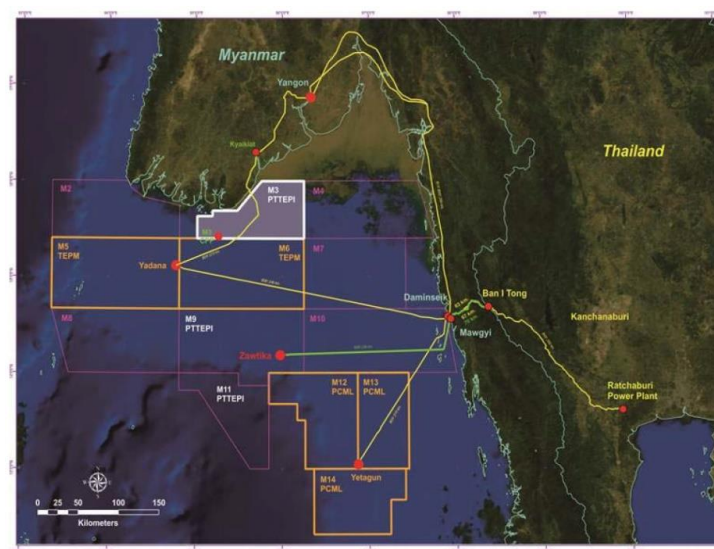


Figure 1-1: Block M3 – Aung Sinkha Field, Offshore Myanmar

The development of Phase 1A consists of the following facilities, as illustrated in Figure 2.0.

- 2 Wellhead Platforms (WPA-1 and WPA-2)
- 1 Intra-field pipeline which links between WPA-1 and WPA-2
- 1 Multiphase export pipeline to transport combined fluid of WPA-1 and WPA-2 to ASK Onshore Processing Facilities (APF)
- ASK Onshore Processing Facilities (APF)
- Onshore pipelines from APF to Gas Receiving Station#2 (GRS#2)
- Onshore infrastructure i.e. condensate offtake facilities, accommodation, Personal Material Transfer Facilities, telecommunication system, roads, etc.
- APL01 Onshore pipeline from landfall to APF

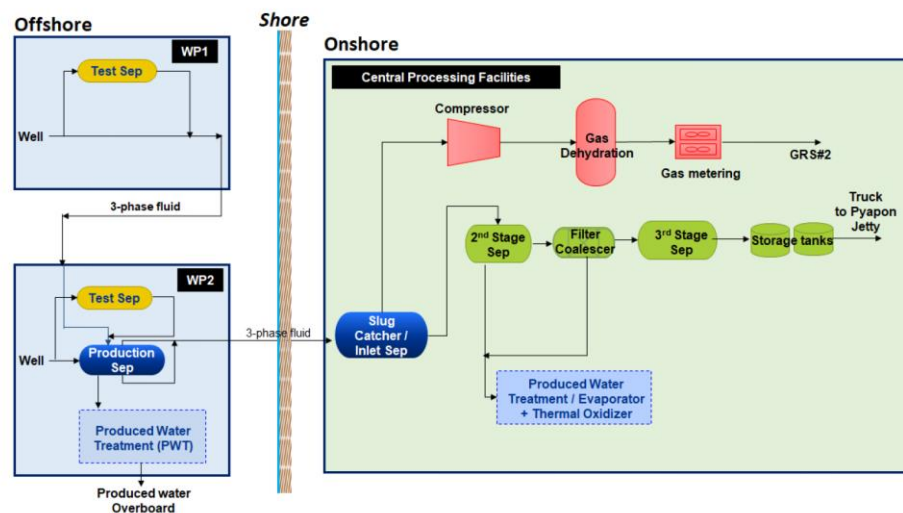


Figure 1-2: Field Block Flow Diagram

1.2 Abbreviation

AC	Alternating Current
ASTM	American Society for Testing and Materials
CP	Cathodic Protection
CSE	Copper/Copper Sulphate Reference Electrode
DC	Direct Current
HHVAC	High Voltage Alternating Current
ICCP	Impressed Current Cathodic Protection
KP	Kilometre Point
LEF	Longitudinal Electric Field

PPE	Personal Protective Equipment
PTTEP	PTT Exploration and Production Public Company Limited
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
ROW	Right of Way
V _{oc}	Open Circuit Voltage

1.3 The Parties Involved

COMPANY	PTTEP International Limited
CONTRACTOR	For the purposes of this document, CONTRACTOR shall mean any person who has entered into a formal written contract with the COMPANY for the performance of work and or services for and or in connection with the COMPANY for and or in connection with ASK Development Project, or any part thereof.
SUBCONTRACTOR	For the purposes of this document, SUBCONTRACTOR shall mean any person to whom the performance of any part of the WORK is subcontracted including subcontractors of any tier.
SUPPLIER or VENDOR	For the purposes of this document, SUPPLIER or VENDOR shall mean a supplier of any of; skid mounted assembly, packaged equipment and associated items, itemized (tagged) materials and equipment, linepipe and associated materials, non-itemized (bulk) materials and all other materials and things, for use in the ASK Development Project or for handover to the COMPANY. The term VENDOR shall include vendors of any tier.

2. GENERAL INFORMATION

2.1 Purpose of Document

This specification defines specification for soil resistivity survey & testing in Basic Engineering Study for Aung Sinkha Development Project Phase 1A. All pipelines are operated and in “Severe Sour Service” condition.

Cathodic protection, coatings, supply of flanges, fittings and additional requirements for the supply of bends and other items pertaining to subsea pipeline systems are presented in separate specifications.

2.2 Language

The English Language shall be used in all project communications, reports, correspondences, drawings, specifications, calculations, and invoices etc., submitted to COMPANY. All drawings and documents shall be annotated in S.I. units with other units in parenthesis, where applicable.

In this document, the words should and shall have the following meanings:

Approval	The authorization in writing given by the COMPANY to the Contractor on a procedure or to proceed with the performance of a specific part of the work without releasing in any way the Contractor from any of his obligations to conform with the technical specifications, requisitions, etc. The words “Approve”, “Approved” and “Approval” shall be construed accordingly
Purchase Order	The order issued by Purchaser consisting Terms and Conditions and attachments thereto including but not limited to Data Sheets and Drawings, Specifications including referenced documentation therein, and all other documents and attachments.
Shall	Used to indicate that a provision is mandatory.
Should	Used to indicate that a provision is not mandatory but is recommended as good practice.
May	Used to indicate that a provision is optional
PPS	Designates Project Particular Specification detailing the additional tests and requirements or the possible modifications to the present specification, based on the particular design conditions or the local legislation of the project.

2.3 Reference Document

This specification defined as the Project Particular Specification (PPS) shall be read jointly with the following COMPANY's general specification:

MM-ASK-1A-APF-COR-SPE-0001	Specification for DC Decouplers and Over Voltage Protector
MM-ASK-1A-APF-COR-SPE-0002	Specification for Insulating Flange Kits and Monolithic Isolation Joint
MM-ASK-1A-APF-COR-SPE-0004	Specification for Cathodic Protection System Installation
MM-ASK-1A-APF-COR-SPE-0005	Specification for Onshore Cathodic Protection
MM-ASK-1A-APF-COR-SPE-0007	Specification for Internal Corrosion Monitoring
MM-ASK-1A-APF-COR-PHI-0001	Cathodic Protection Design Philosophy
MM-ASK-1A-APF-COR-RPT-0002	Cathodic Protection System Conceptual Design Report
MM-ASK-1A-APF-COR-MTO-0001	Provisional Material Take Off for Cathodic Protection System
MM-ASK-1A-APF-COR-SPE-0003	Material Specification for Cathodic Protection System
MM-ASK-1A-APF-COR-DTS-0001	Datasheet for Cathodic Protection System DC Decoupler and Over Voltage Protector
MM-ASK-1A-APF-COR-DTS-0002	Datasheet for Cathodic Protection System Pipeline Insulation Joints and Gasket Kits
MM-ASK-1A-APF-COR-TYP-0001	Typical Installation Details for Cathodic Protection System Cover Sheet
MM-ASK-1A-APF-COR-TYP-0002	Typical Installation Details for Cathodic Protection System Index
MM-ASK-1A-APF-COR-TYP-0003	Typical Exothermic Welding Installation Details
MM-ASK-1A-APF-COR-TYP-0004	Typical Test Station Installation Details (Type A)
MM-ASK-1A-APF-COR-TYP-0005	Typical Test Station Installation Details (Type F)
MM-ASK-1A-APF-COR-TYP-0006	Typical Test Station Installation Details (Type D)
MM-ASK-1A-APF-COR-TYP-0007	Typical Test Station Installation Details (Type CR for Foreign Pipeline)
MM-ASK-1A-APF-COR-TYP-0008	Typical Test Station Installation Details (Type E)
MM-ASK-1A-APF-COR-TYP-0009	Typical Test Post Guard Rail

MM-ASK-1A-APF-COR-TYP-0010	Typical Sacrificial Anode Installation Details (Type AM)
MM-ASK-1A-APF-COR-TYP-0011	Typical DC Decoupler Installation Details
MM-ASK-1A-APF-COR-TYP-0012	Typical Test Station and Bond Box Details
MM-ASK-1A-APF-COR-SCH-0001	CP/AC Schematic Diagram and Test Facility Schedule

The present PPS provides confirmations and/or modifications and/or additional requirements to the COMPANY's general specification. The matters covered in the general specification, which are not mentioned under this specification, shall apply in full.

2.4 Regulation, Standards and Code of Practice

The Aung Sinkha Development Project shall be designed primarily in accordance with PTTEP's general specifications (PEGSs) and corporate specifications, as appropriate, and the applicable Myanmar legislative requirements. Where such standards are not applicable, accepted international codes/industry good engineering practices will be adopted. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published on the effective date of a contract.

Any deviation from the standard shall be documented for derogation and proper permission from PTTEP in writing.

The order of precedence of the applicable documents shall be:

- 1) Government Laws, Rules and Regulations
- 2) Purchase Order/ Service Order/ Contract Documents
- 3) Data Sheet, Drawings and Project Particular Specification (PPS)
- 4) PTTEP Engineering General Specification (PEGS)
- 5) Other COMPANY specifications, standards, and documents
- 6) International Codes and Standards

In case of conflicts/contradictions between the various codes, standards, regulations and specifications, unless otherwise agreed or decided by COMPANY, it is understood that the more stringent requirement shall apply.

Exceptions to or deviations from this specification are not permitted unless they have been raised during the bidding stage and previously accepted in writing by the COMPANY. For this purpose, requests for substitutions or changes of any kind shall be completed with all pertinent information required for COMPANY assessment. COMPANY's approval, nevertheless, will not, in any way, relieve the SUPPLIER's responsibility to meet the requirements of the industry Codes and Standards referred to and amended herein, in the event of a conflict.

2.5 CONTRACTOR/ SUPPLIER's Responsibility

All work shall be carried out in compliance with this specification, reference documents, Codes and Standards, and Specifications listed unless otherwise stated. The SUPPLIER's submissions should provide sufficient data to allow the equipment to be evaluated against the total life and field costs estimated to be incurred. In this respect, equipment capital cost, weight, size, cost of spares, utility and power requirements, maintenance, reliability and production downtime costs may be considered.

SUPPLIER is required to have relevant proven prior experience in the fabrication and testing of line pipes, which is to be supplied.

3. CODES, STANDARDS AND REGULATIONS

The following codes, standards and specifications (latest edition) have been used or/are referred to in this specification. In the event of conflict the Contractor shall inform Owner/Consultant.

NACE SP0169	Recommended Practice "Control of External Corrosion on Underground or Submerged Metallic Piping Systems"
NACE SP0177	Recommended Practice "Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control System"
NACE SP0286	Recommended Practice "The Electrical isolation of Cathodically Protected Pipelines"
NACE TM0497	Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
10008-STD-6-COR-022-R00	Design of Cathodic Protection of Buried Pipeines
10008-STD-6-COR-023-R00	Design of Cathodic Protection of Onshore Facilities

4. SITE CONDITIONS

The Environment outside buildings (climatic) at normal operating conditions in per the Weather Forecast Bureau recorded temperature minimum/maximum of 10°C and 42.2°C respectively and humidity of 11% to 95.2%.

The Environment inside buildings at normal operating conditions are temperature within air conditioned Control Rooms, in the range of minimum/maximum 22°C -25°C.

5. SURVEY METHOD

5.1 Four Pin Wenner Test Method

The Survey shall be conducted using The Four Pin Wenner Method of determining soil resistivity. Testing requires driving four steel pins into the ground at equal spacing in a straight line, with the pin separation equal to the depth to which the average/apparent soil resistivity is to be measured/recorded.

The pins shall be driven into the ground a sufficient depth to ensure that good contact with the soil is made, in dry or sandy soils/loams a small amount of water or a similar electrolyte may be required and shall be poured around the pin to reduce contact resistance.

The average soil resistivity is a function of the voltage drop between the two centre pins when an alternating current is flowing between the two outer pins. The resistance of the soil under test is measured as a function of the applied current (generated by the test meter) and the recorded voltage drop in accordance with Ohm's law. The soil resistance in Ohm's (Ω), is then read directly from the meter display of the AC Ohmmeter/Soil Resistance meter.

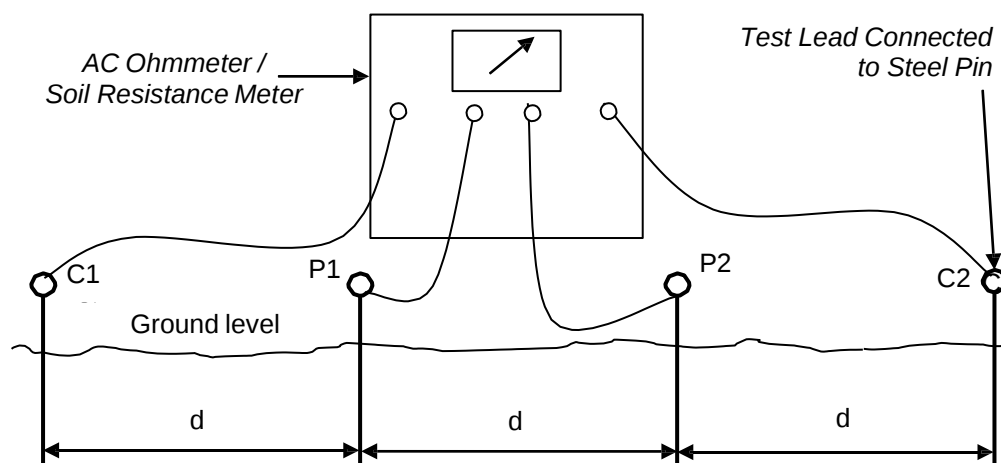


Figure 4-1: 4 Pin Wenner Test Arrangement

The average/apparent resistivity of the soil at the designated depth is determined from the formula:

$$\rho = 2 \times \pi \times R \times d$$

Where:

ρ is the average or apparent soil resistivity (Ω -cm)

R is the measured resistance on the AC Ohmmeter / Soil Resistance Meter (Ω)

d is the spacing between the pins in centimetres(cm)

Soil Resistivity Survey Data shall be collected on appropriate record form. The data shall then be entered onto a computer spread sheet in the same format and the sheet saved using the specific kilometre point (KP) location as a unique reference.

The Barne's layer analysis shall be accomplished using the data entered into the computer spread sheet. The analysis is based upon calculating the resistivity of the soil in each incremental layer of soil, this shall be achieved by using the survey collected Wenner four pin test data to determine the conductivity of individual soil layers, and then converting the conductivity values to corresponding resistivities.

The computer generated forms complete with Barne's layer analysis shall then be compiled into a report of the average soil resistivities recorded at respective depths and locations along the pipeline route and associated project facilities, block valves etc.

Soil chemical analysis sampling at 5 km interval shall be taken to verify the corrosiveness of the soil along the entire pipe route.

CAUTIONARY NOTE

It is important that prior to performing any soil resistivity testing, that the general area be inspected for the presence of parallel buried conductors such as existing pipelines, railway lines etc, which can potentially give rise to spurious/erroneous readings during testing. In situations where parallel HHVAC power lines or conductors are present or suspected, pins should be arrayed perpendicular to the proposed pipeline route/ buried conductors to minimize any undue influence/effects.

5.2 Longitudinal Electric Field Test Method

Dividing the pipeline-powerline route into sections, where the pipeline along each section has uniform electrical characteristic to ensure that the LEF along each section has a constant magnitude and phase angle.

Two ground rods 10m shall be placed in the ground. The spacing of the two ground rods shall be 10m. The well-insulated wires shall be parallel to the powerlines and in the approximate positions that the pipeline will be constructed.

A single core 2.5mm² PVC/PVC insulated test lead approximately 10m long, shall be connected to ground rod #2 and to the common terminal (-Ve) of the high input impedance voltmeter, located adjacent to ground rod #1. The test lead shall be laid in a straight line on the earth above and following the centre line of the pipe.

A second 2.5mm² PVC/PVC insulated test lead less than 1m long shall be connected to ground rod #1 and the voltage (+Ve) terminal of the voltmeter as shown in Figure 4-2.

The open circuit voltage, (Voc), developed across the insulated test lead is measured on the voltmeter.

Longitudinal Electric Field is determined from the formula:

$$LEF = \frac{V_{oc}}{10}$$

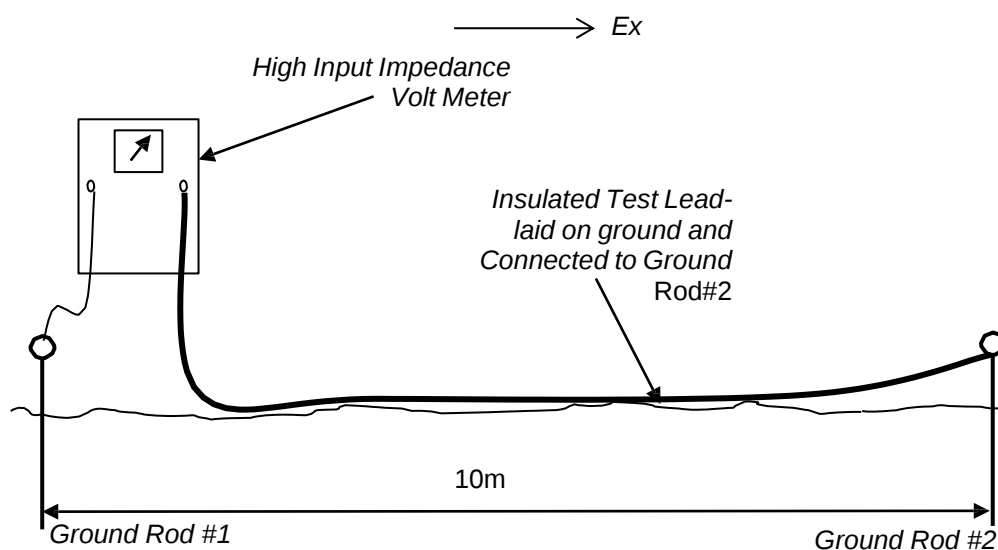


Figure 4-2: LEF Test Arrangements

6. SURVEY SCHEDULE

6.1 Four Pin Wenner Testing

The Four Pin Wenner Method of Testing and determining soil resistivity and the Barnes Method of Layer Analysis shall be utilised along the entire accessible length of the pipeline route in accordance with the following schedule:

1. Readings at pin spacing/depths 1m, 2m, 3m, 5m and 10m at 1 km intervals as per specification no. MM-ASK-1A-APF-COR-SPE-0005.
2. Readings at pin spacing/depths 1m, 2m, 3m, 5m and 10m at every adjacent HHVAC tower and pole rated 22Kv or greater and every major pipeline or HHVAC system crossing.
3. Readings at pin spacing/depths 0.5m, 1m, 2m, 3m, 5m, 10m, 15m, 20m, 25m, 30m, 40m, 50m, 60m, 70m, 80m, 90m and 100m, 120m and 160m at all proposed groundbed locations (stations).

6.2 Chemical Analysis

Soil Chemical analysis shall also be conducted at intervals of no more than 5 km to ascertain the corrosive nature of the soil and shall include as a minimum:

- Soil Conductivity/Resistivity
- Presence of Sulphate Reducing Bacteria
- Minimum water content

6.3 Soil pH/Redox Potential Testing

Soil pH testing using redox (antimony) probe and copper/copper sulphate reference electrode shall be conducted at 1km intervals.

6.4 LEF Testing

LEF testing shall be utilized along the entire accessible length of the pipeline route in accordance with the following schedule:

- At parallelism with HHVAC power line(s) – beginning and end and at 1km intervals.
- At crossings with/of HHVAC power line(s)

7. REPORTS

The report shall contain the following information:

- Locations of test
- Soil resistivity, soil pH and Longitudinal Electric Field (10m) field collected data
- Data collection sheets with test points uniquely identified and applicable graphic and schematic layout presentations
- Data Analysis
- Conclusions
- Recommendations
- Other information as may be pertinent or required

END