UCH COMPRESSION PROJECT

Design Engineering, Procurement (Supply), Construction, Installation/Erection, Pre-Commissioning, Commissioning & Start-up (including performance testing and Reliability Guarantee Test) of Compression System at UCH Compression Project

Tender Enquiry No. PROC-FC/CB/PROJ/UCH(COM)-4462/2019

Pre-Bid Clarification-06

Sr.	Reference	Description in Tender Documents	Queries	Response
1	iv of Clause-11.11b), Page-21 of 77, Condition of Contract	Within the premises of UCH plant area contractor will establish their own Camp area.	We understand that area for Camp for EPCC Contractors personnel, equipment and materials will be within OGDCL's UCH Plant premises, but outside Main Plant Area and sufficient land / area shall be provided by OGDCL without any charges / rent etc. please confirm.	Please refer section IV Conditions of Contract clause 13.
2	Clause-1.1.7, Page-7 f 114, Scope of Work	The EPCC Contractor shall provide a temporary camp for his own personnel, equipment and materials in the vicinity but outside the UCH Gas Plants.		
3	Item-o of 11.2, Page-16 of 77, Condition of	The contractor shall provide the **NOC** on the judicial stamp paper regarding Reconciliation		

	Contract	Report, As-Built Drawings, Construction Dossier, Operation /Maintenance Manuals and no claim.	We understand that the NOCs referred under Sr.No.3 and 4 are same document, and the NOC mentioned in Sr. No.5 is different and shall not be linked with any payment milestone. Please confirm.	Bidder should note that "clearance of punch list" is also mentioned in section 24.2 (6b). For payment milestones please refer 24.2 (6b). Whereas required NOC's are mentioned in Section 24.2 (6b), 11.2 & 69.
4	Milestone# 6b of a) of 24.2, Page-35 of 77, Conditions of Contract	Final payment upon submission of certificate showing clearance of punch list, submission of material reconciliation report, As-Built Drawings, Construction Dossier, Operation / maintenance Manuals and **NOC / NCC (No Claim Certificate).**		
5	Clause-69, Page-71 of 77, Conditions of Contract	Whereas, following documents shall be submitted after the completion of Defect Liability Period: **c) Undertaking/No Claim Certificate on judicial stamp paper.**		
6	39.6 of Clause-39, Page-52 of 77, Conditions of Contract	The Contractor shall arrange to carry out a **pre-shipment inspection** of the supplies through approved third party	We understand that Pre-Shipment Inspection shall be carried out at Manufacturing Facility and Loading Port through Approved Third Party Inspection Agency for **Foreign Supplies Only** and	Bidder understanding is correct. Further, bidder to confirm to adhere with the requirements as mentioned in tender document.

		inspection agency.	further imported material shall be inspected by OGDCL / ENAR/ Contractor's representative at Project site as Inspection at Discharge Port would be useless as well as impractical. Inspection of Local Supplies shall only be carried out at Project site by OGDCL / ENAR/ Contractor's representative and Third Party Pre-Shipment Inspection is not required. Please confirm.	
7	Appendix-M	The scope for Open Box **Pre-shipment inspection**, **inspection at loading Port of shipment & inspection at unloading Port of Discharge** of Equipment/ Packages shall be carried/verified out by third party inspector for assuring the integrity of shipment/packing		
8	Clause-13 & 14 of Attachment-2	Any demurrage paid by OGDCL due to inconsistency in B/L and manifest will be recovered from beneficiary. **In addition above demurrage due to any reason shall be on beneficiary account.**	We understand that demurrage caused by due to any mistake/ reason of Contractor shall be beneficiary account. If any demurrage caused by due to any mistake / reason of OGDCL's scope / responsibility shall be on account of OGDCL. Please confirm.	Not acceptable. Bidder to adhere with the requirements as mentioned in tender document.

9	Second Para under Title of "Foreign Bidder", Page-4 of 35, Instructions to Bidders	The payment of custom duties & taxes, port charges (delivery order, de-stuffing, terminal, container retention, clearing/brokerage, demurrage (if any) and any allied charges), custom clearance, inland transportation & insurance, unloading & storage at site or any other shall be sole responsibility of the bidder/contractor. OGDCL shall only arrange marine insurance from NICL on behalf of contractor for the imported goods from port of loading up to port of unloading and its expenditure shall be on part of the contractor and it shall be recovered on actual from any due	We understand that 1.OGDCL shall arrange Marine Insurance at its cost from NICL for to be Imported Goods which shall cover transit from Loading Port to Project site. 2. Please clarify the discrepancy of both clauses related to custom clearance and transportation.	Foreign supply component needs to be qouted on CFR basis, only for the purpose of processing letter of credit. However the payment of custom duties taxes, marine insurance, port charges (delivery order, de-stuffing, terminal, container retention, clearing/brokerage, demurrage (if any) and any allied charges), custom clearance, inland transportation & insurance, unloading & storage at site or any other shall be sole responsibility of the bidder, these charges shall qouted & paid in Pak Rupees only. These charges are already covered in bidder scope in Appendix-C2 under head of 6.0 Insurance (6.4) and 7.0 General Services (7.3 & 7.4).
10	Item-k of Clause-11.8, Page-57 of 114, Scope of Work	**Marine Insurance (from Port of loading to Project site) Custom Duties, Custom Clearance and Inland Transportation will be done by OGDCL.**		

11	Clause- 4.14 to 4.16, Page-33 of 114, Scope of Work	/	Contractor's Scope of Work for Relocation of Diesel Tank and Tanks shall be limited to electrical equipment of the Diesel System only? or whole system is to be relocated by the EPCC contractor (reference clause 12.3.12.6 and 12.3.12.7 of Scope of Work)? Please clarify.	Please note that it is the responsibility of Contractor/bidder to evaluate the existing system/equipment that are comes under the relocation scope and if it is fit and suitable for further use (reuse/reutilize), as far as reasonable, shall be installed accordingly, otherwise new material/equipment shall be designed and provided accordingly as required without any additional cost and time. Further note that it is the responsibility of bidder and the part of their due diligence, to visit site before submission of proposal and obtain all the information at their own and ascertain & consider all the anticipated/additional material in their scope that may require at the time of detail engineering or during execution phase. Deviation at later stage shall not acceptable. Bidder/Contractor shall document every relocation equipment and make recommendations as to whether equipment condition warrants reinstallation, fit for re-utilization or not. In either case, client approval shall be sought.
12	Clause-7.10, Page-45 of 114, Scope of Work	The EPCC Contractor shall also be responsible for any re-location of and	OGDCL to provide Overall Underground Services Layout for our working and understanding.	Bidder to carry out a site visit for understanding the scope. Further, underground layouts shall be shared with

		piping (above ground or buried) due to any modification.		successful bidder.
13	Clause-13.2, Page-96 of 114, Scope of Work	EPCC Contractor will conform to the recommendations of **Environment Impact Assessment** (already performed by OGDCL for complete UCH Plant through its pre-qualified third party) during the execution of the Work. The UCH Compression Facility will be designed, constructed and commissioned so that during operation it conforms to all requirements of the EIA.	Please provide the Environment Impact Assessment for Compliance.	The study will be carryout by OGDCL and report will be shared to successful bidder.
14	Datasheet for Centrifugal Compressor (Doc No. 0221-DS-1701)	Line.No.36, Sheet 2 of 8: Certified Point: Case 2, Case 3.	As per Industry practice, typically Client (OGDCL) should specify one normal operating point which is also the certified point. Additionally, **ONLY ONE** certified/guarantee point can be specified. Please confirm which point shall be the guaranty point.	The compressor package shall be designed in such a way that all cases shall be met under the performance curve of the compressor package.
15		Line No.38, Sheet 2 of 8: Process Control	OGDCL has specified both suction throttling and speed variation as process control method, and the specified suction throttling pressure is higher than	Suction throttling valve shall be required for initial compression scenarios as stipulated in the referred datasheet i.e. 835 to 500 Psig.

			the suction pressure of any operating point. Please clarify that for control purposes which control method shall take precedent.	Furthermore, EPCC shall propose or provide viable and optimum controlling method for overall operating envelope.
16		Requirement of Turbine Power and Compressor Flow Margins.	As in **Guarantee points section**, it is clearly defined the design pressures & we understand as per **'Note'** that **Power of Turbine should be at least 10% in excess of maximum required BHP required** for compressors at extreme case without inlet air cooling at 130 Deg F. Whereas under section Vol-II→II A Process→Datasheets→0221-DS-1701-0 (Spec for Centrifugal Compressors)→ Notes It is requested that "**EPCC TO DESIGN COMPRESSORS CONSIDERING 10% DESIGN MARGIN ON FLOW** AND PROVIDE COMPRESSOR RUNS AT 110% DESIGN AND 25% TURNDOWN FOR EACH CASE." We understand that **EPCC / Packager to consider only 10% design margin on power for the worst case** as per the guarantee points section and **EPCC / Packager don't need to consider**	Referring to Sec 8.2.1(f) of 0221-GS-9510-3 (Spec for Centrifugal Compressors); "The Gas Turbine shall be capable of developing at least 110% of the power input requirement, at site rated conditions, when the compressor is working rated compression scenario i.e. maximum flow and compression ratio." Bidder to adhere with stipulated the tender requirements.

			<u>additional 10% margin on flow</u> as it shall be unreasonably increase the size of Compressor as well as Turbine due to double design margin. Please clarify.	
17		Line No. 62, Sheet 2 of 8: Note No.7: EPCC Shall also provide one additional run on 250 Psig suction pressure.	Additional run at 250 PSIG is specified. Please clarify that what is the gas composition and target discharge pressure for this additional run?	Composition of Case-03 is to be considered for additional case, however, the discharge pressure would be the same i.e. 865 Psig.
			Process gas has liquid @ current condition. Please provide composition after liquid remover (knock out drum or de-humidifier). Because Compressor will not take any liquid.	
19	Item-s of Clause-3.2.1.2, Page-20 of 35, Instructions of Bidders	The OEM must have adequately sized test bench for the quoted model of Gas Turbine and Compressor within their Facility which will be used to carryout FAT of all machines efficiently.	Please clarify that PTC-10 performance test should be carried out for all three identical casings?	Bidder understanding is correct. Further, Bidder to adhere with the tender requirements.
20	Clause-3.4.1, Page-23 of 35, Instructions of Bidders	The performance will be extrapolated using ASME PTC-10/applied codes and standards as per industrial	Please be informed that PTC-10 performance test for Compression Facilities at site will be extremely costly and time consuming.	Not acceptable. Further, Bidder to adhere with the tender requirements as per Clause-3.4.1of 'Instructions to Bidders'.

		practice and mutually agreed. The performance of the maximum power of the turbine at maximum ambient temperature .e. 55oC shall be met without any prior inlet air cooling system	It is not suggested to carry out site PTC-10 performance test. Please confirm	
21	Clause-12.3.12.13, Page-73 of 114, Scope of Work	The Soil Investigation Report of UCH II Plant is provided in Appendix–I of this document.	Referred attachment is missing, kindly provide the same.	Please find attached.
22	Clause-2.1, Page -6 of 26, SPECIFICATION FOR ROTARY SCREW COMPRESSOR PACKAGE (0221-PA-2011)	0221-IMA-6001: General Specification for Instrumentation & Control	Please provide the Document No. 0221-IMA-6001.	Kindly refer Document 0221-IMA-6000-0 (Specification for General & Packaged Instrumentation).already part of tender document.

SOIL TESTING SERVICES

KGI – 2011 – 268

SOIL INVESTIGATION FOR UCH-II DEVELOPMENT PROJECT

Client: Oil & Gas Development Corporation Limited

Consultant: ENAR Petrotech Services (Pvt.) Limited

| January 2012

SOIL TESTING SERVICES

GEOTECHNICAL ENGINEERS

&

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EXECUTIVE SUMMARY

Geotechnical Investigation for UCH-II Development Project, Dera Bugti was carried out in the period of December 2011 to January 2012. Twenty-five boreholes were drilled and ten electrical resistivity tests were carried out as part of the field investigation. Soil and groundwater samples were also collected during the field investigation. Laboratory testing of these samples has been carried out in the lab and includes determination of index properties through grain-size analysis, Atterberg limits, density and specific gravity tests.

The ground conditions observed at the site indicate the presence of very dense silty fine sand in the boreholes drilled in the plant area while very stiff to hard clayey silt has been encountered in three boreholes in the well head area. Groundwater table has not been encountered in any borehole drilled at the site.

Keeping these conditions under consideration allowable bearing pressures for isolated and raft footings have been given. Seismic soil profile has been taken as 'S_C' in accordance with UBC-97.

Non-aggressive chemical characteristics of the subsurface soil have influenced the selection of cement for underground concreting and it is recommended to use *Ordinary Portland Cement (OPC)*.

The corrosiveness of the ground up to 5 meters below existing ground has been determined through electrical resistivity tests and very high resistivity values indicate non- corrosiveness of the subsurface deposits.

CONTENTS

1. INTRODUCTION

Oil & Gas Development Corporation Limited (OGDCL) is planning the development of the **UCH-II Project** at Dera Bugti, Balochistan. In order to determine the geotechnical parameters of the subsurface deposits and to carryout foundation design of the structures, *Soil Testing Services (STS)* were hired by the consultants for this project. *ENAR Petrotech Services (ENAR)* entrusted to carry out the geotechnical investigation works.

The geotechnical field investigation and laboratory testing was conducted by STS in the period of December 2011 to January 2012. Scope of work included drilling of twenty-five boreholes and carrying out electrical resistivity tests at ten locations. In each borehole field tests, including standard penetration test, were carried out along with the collection of undisturbed soil samples, laboratory testing and preparation of report including recommendations for foundation design.

The report consists of seven chapters with *Chapter 2* describing the site's existing condition, *Chapter 3* discusses the on site testing and drilling activities, *Chapter 4* describes the performance of laboratory tests, *Chapter 5* describes the subsurface deposits in detail, *Chapter 6* includes the recommendation for foundation design and *Chapter 7* contains a summary of conclusions regarding the ground conditions, with respect to geotechnical engineering for this project.

2. THE SITE

The site is located in the tribal Dera Bugti Agency, Balochistan. UCH-II Development Project is located besides the UCH-I Power Plant. The project area lies on relatively flat area and there are no major elevation changes across the investigated area, either in the plant area or at the well head. Besides the existing power plant other major feature near the site is the OGDCL staff camp.

3. DRILLING, FIELD TESTING & SAMPLING

The field testing program consisted of drilling works, excavation of test pits, in-situ testing including Standard Penetration Tests (SPT) and collection of soil and water samples including undisturbed sampling through Shelby tubes from clay samples. The following sections describe these activities in further detail.

3.1 DRILLING METHOD

All the boreholes were drilled by rotary wash boring method. In rotary drilling following drilling bits were used with different kinds of subsurface conditions:

- Tricone Bit – silty sands and clay
- Core Barrel – hard clay

3.2 FIELD TESTING AND SAMPLING

Field testing was carried out in boreholes. The tests included:

- Standard Penetration Test (SPT)

Soil samples were extracted from all the boreholes with the help of following tools:

- SPT sampler for all types of soils
- Rock coring for hard clay

Following sections indicate the processes carried out in each of the field tests and sampling.

3.2.1 STANDARD PENETRATION TESTS (SPT)

The standard penetration tests (SPT) were carried out at 1.5m interval in the overburden above the bedrock. The standard penetration test was carried out by *"Safety"* type sliding hammer. Split-spoon sampler was used in cohesive and fine granular soils to conduct SPT.

The standard penetration test was carried out by an assembly of the following parts:

- Drive-weight assembly, consisting of a drive-weight assembly that consists of a drive head and a 63.5kg impact hammer, a hammer fall guide and the drop system. The drop mechanism will ensure a constant free fall of 760mm.

- Drive rods connect the drive-weight assembly to the sampler.

- The split spoon sampler was used to carryout the test, along with retrieving disturbed samples.

The base of the borehole was made clean and reasonably undisturbed at the test elevation. Following precautions were taken during the testing sequence:

- The level of water or bentonite slurry was maintained at a sufficient level above the groundwater level, to ensure any entry of water through the bottom of the borehole.
- The casing was not driven below the level at which the test will start.

The test was executed in the following steps:

- The sampler and the drive rods were lowered in the borehole and the hammer assembly added to it.
- The sampler is penetrated over seating drive of 150mm and the numbers of blows are recorded.
- In the same way the sampler is driven over a test drive of 300mm in two increments of 150mm.
- The numbers of blows are recorded during each of the last two increments.
- The test was deemed finished when total number of blows equal to 50 was reached.

3.3 SAMPLING

Sampling forms an essential part of the geotechnical investigation process and good sampling is essential for proper laboratory testing of samples for determining strength and compressibility characteristics of soil.

3.3.1 SPT SAMPLES

Samples were recovered from standard penetration testing. The samples were recovered in split-spoon sampler and then stored in plastic bags. The storage of split-spoon samples in jars ensured retention of natural moisture of the samples which were later determined in the laboratory.

4. LABORATORY TESTING

Laboratory testing was carried out on the retrieved split-spoon samples and rock cores. The following section enlists and gives details of relevant tests carried out on select samples as required for determining the subsurface conditions and correlating with the information obtained from field testing and sampling.

4.1 GRAIN SIZE ANALYSIS

The purpose of grain size analysis is to determine the sizes of the assemblage of particles that make up the soil. The grain size analysis is conducted in two parts: for particles above the "# 200 US sieve", sieve analysis is carried out by passing the selected soil sample from various sieves. For particles finer than the "# 200 US sieve", hydrometer analysis is carried out. The combined process of determination of the size of particles is termed as the grain size analysis.

The subsurface deposits encountered at the project site up to the explored depth of 20m consist of fine to medium grained sands. The grain size analysis, of the samples retrieved from SPT, show very minute percentage of particles finer than 75µm (# 200 sieve). Therefore, hydrometer analysis was not carried out on the samples. The samples were prepared in accordance with ASTM D 420 and the grain size analysis was carried out in accordance ASTM D 422.

The results are appended with the report in Appendix C. Grainsize analysis of fifty-three (53) soil samples were carried out.

4.2 LIQUID AND PLASTIC LIMITS

The liquid and plastic limits of soil are parameters that define the state of the soil at different water content levels. The liquid limit is the water content above which the soil goes from solid phase to liquid phase and the plastic limit indicates the water content below which the soil mass makes the transition from a plastic, remouldable solid to a brittle mass which can not be remoulded any more. The difference in the water contents at Liquid and Plastic limits is termed as the plasticity index and it is a measure of the plasticity of the soil under consideration. The samples used for determining the limits are finer than the "#40 US sieve". The limits were determined in accordance with the ASTM

D 4318.

Liquid and plastic limits of four (04) samples were carried out in accordance with the given procedure. The soils plot below the A-line and can be classified as low plasticity silts with minute percentage of clay minerals.

4.3 CHEMICAL TESTS

Sulphate in groundwater or soil can attack concrete placed in the ground or on surface. A reaction takes place between the sulphate and the aluminate compounds present in the cement, causing crystallisation of complex compounds. The expansion, which accompanies crystallisation, induces stresses in the concrete, which results in mechanical disintegration.

In moist conditions, such as exposure to seawater, the presence of chloride ion, Cl^-, presents a serious possibility of the corrosion of the reinforcement. The presence of Ca $(OH)_2$ provides a strong alkaline environment in which a thin film of iron oxide is formed on the metal surface which protects it against corrosion. However, if the concrete is permeable to the extent that the soluble chlorides can reach up to the reinforcing steel, then in the presence of water and oxygen, the corrosion of the reinforcement will take place. Rust occupies more volume than the original steel, and hence the ensuing expansion of concrete, results in cracking and spalling.

Due to adverse effect of sulphates and chlorides on the quality of concrete it is essential to conduct chemical tests on soil and groundwater. This helps in quantifying the expected exposure of concrete to these chemicals and in devising precautionary measures to ensure integrity of concrete.

The following chemical tests were carried out on soil samples:

- Total dissolved solids
- Chloride content
- Sulphate content
- pH

Chemical tests were carried out in accordance with *BS 1377-3*. Chemical characteristics of soil samples indicate negligible exposure of chloride and sulphate salts. The selection of cement for underground concreting and is discussed in *Chapter 6*.

Table 4.1: ACI standards for concrete for sulphate exposure

Sulphate Exposure	Water Soluble Sulphates in Soil (%)	Sulphate in Water (mg/L)	Cement Type
Negligible	0.00-0.10	0- 150	OPC
Moderate	0.10-0.20	150- 1500	Type II
Severe	0.20-2.00	1500-10000	Type V
Very Severe	Over 2.00	Over 10000	TypeV plus pozzolan

4.4 UNCONFINED COMPRESSION TEST

Unconfined compressive strength test involves axially loading a cylindrical soil sample to failure. The term unconfined is used because the lateral force on the sample is zero. While, unconfined compression test is a convenient method of determining strength, the results thus obtained can not be assumed to represent the actual strength of soil as the lateral confinement is not present and in its undisturbed state the soil is confined by lateral pressure. The unconfined compressive strength test was carried out in accordance with *ASTM D 7012.*

5. GROUND CONDITIONS

The subsurface deposits up to the explored depth of 15m consist of the following units:

- Medium stiff to hard clayey silt
- Medium to very dense silty fine Sand

Following sub-sections describe the strength characteristics of the geological units. Groundwater was not encountered in any borehole drilled at the site.

5.1 CLAYEY SILT

These soil deposits are found in three boreholes drilled in the *Well Head Area* of the project. The deposits are in a medium stiff to hard state of consistency as indicated by the SPT *'N'* count data. Laboratory test results from the unconfined compression and direct shear test confirm the field data and the samples show unconfined undrained strength of 300 to 500 kPa. The soil has been classified in the *'ML'* category of *Unified Classification System*.

5.2 SILTY FINE SAND

Silty fine sand was encountered in all the boreholes drilled in the *Plant Area* of the project. The SPT *'N'* count data indicates medium to very dense state of compactness. The soil has been classified in the *'SP-SM'* category of *Unified Classification System*.

5.3 GROUNDWATER CONDITIONS

Groundwater was not encountered in any borehole drilled at the site either in the *Well Head* or *Plant Area*.

6. ENGINEERING DESIGN CONSIDERATIONS

Foundation system has to be designed to prevent excessive settlement or shear failure of soil due to the structural loads. Therefore, considering the ground conditions and the size of structures it is recommended that the buildings be placed on either *Pad* or *Mat Footings* to fulfil the above mentioned design requirements.

6.1 ALLOWABLE BEARING PRESSURE – SHALLOW FOOTINGS

The allowable bearing pressure has been calculated following shear strength determination, through in-situ (SPT) and laboratory (unconfined compression and direct shear) tests. *Table 6.1* gives allowable bearing pressure for shallow foundation placed at different depths.

Table 6.1 Allowable Bearing Pressures

Location	Depth (m)	Allowable Bearing Pressure Pad Footing (kPa)	Allowable Bearing Pressure Raft/Mat Footing (kPa)
Plant Area	1.5 – 2.5	200	240
Well Head	1.5 – 2.5	150	190

The settlement of pad and mat footings due to the net allowable bearing pressures has been estimated to be within the allowable limit of 25mm and 50mm respectively.

6.1.1 DRAINAGE

The foundation must be constructed under dry conditions and adequate drainage must be given to ensure that the soil at founding level is not exposed to water following foundation construction.

6.2 SEISMIC DESIGN COEFFICIENTS (ACCORDING TO UBC-97)

Chapter 16, Division V, Section 1636 of UBC-97 deals with the determination of Soil Profile Types. Design practice involves using seismic parameters of zone 3 for the area under consideration.

6.2.1 SEISMIC ZONE FACTOR

Table 16-I of UBC-97 defines the seismic zone factor to be used in choosing seismic coefficients for a location. The seismic zone factor **"Z"** will be taken as 0.30.

6.2.2 SOIL PROFILE TYPE

Table 16-J of UBC-97 defines the soil profile types to be used for determining seismic coefficients. Based on the field data obtained from sub-soil exploration, the soil profile will be taken as **"S_C"** *i.e.* stiff soil for design of structures.

6.2.3 SEISMIC COEFFICIENTS

Seismic coefficients are as under:

For S_C: $C_a = 0.33$ & $C_V = 0.45$

6.3 TYPE OF CEMENT – UNDERGROUND CONCRETING

Tests on soil samples obtained from the borehole indicate 'negligible' Sulphate and chloride exposure. Under these conditions it is recommended to use *Ordinary Portland Cement (OPC)* for all under ground concrete works.

6.4 CORROSION POTENTIAL – ELECTRICAL RESISTIVITY TEST

Electrical resistivity tests were carried out at ten locations within the plant area. The depth of probes at each location was kept at 1m, 3m and 5m.

6.4.1 WENNER FOUR POINT METHOD

The most commonly used method for resistivity testing of soil is the *Wenner Four Point* method. *AEMC 6742* ground resistance tester was used to conduct this test. Accessories include insulated copper wires and metal rods used as electrodes.

It requires inserting four probes into the test area. The probes are installed in a straight line and equally spaced (See Figure 1-1). The probes establish an electrical contact with the earth.

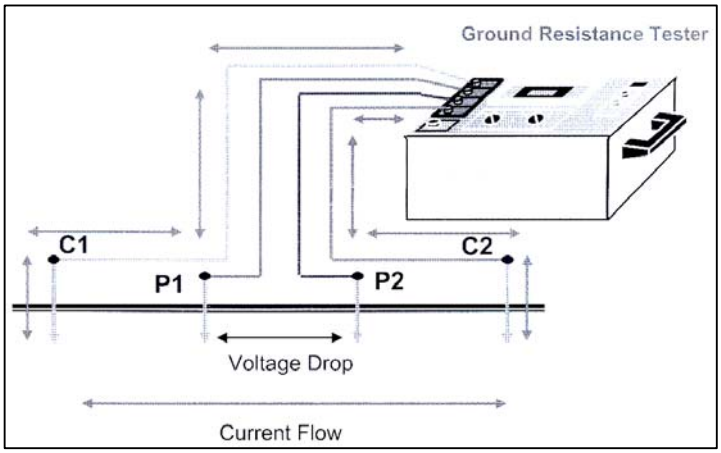


Fig. 6.1 Schematic Diagram of a Wenner Array

The four pole test meter injects a constant current through the ground via the tester and the outer two probes. The current flowing through the earth (a resistive material) develops a voltage / potential difference. This voltage drop resulting from the current flow is then measured between the two inner probes.

The meter then knows the amount of current that is flowing through the earth and the voltage drop across the two center probes. With this information the meter uses ohms law (R=E/1) to calculate and display the resistance in ohms.

This displayed resistance value is in ohms and must be converted to ohms-meter,

which are the units of measure for soil resistivity. Ohms-meter is the resistance of a volume of earth that is one meter by one meter by one meter, or one cubic meter. Readings were taken at probe spacing of 1, 3 and 5 meters.

The calculated soil resistivity is the average of the soil resistivity from the surface to a depth equivalent to the probe spacing. For example, a probe spacing of 5 meters between each probe will provide the average soil resistivity between the surface and a depth of 5 meters.

6.4.2 TESTING PROCEDURE

Equipment and accessories used for this test are as follows:

- A 4-Pole Digital - Ground Resistance Tester
- Four probes
- Four insulated wire conductors
- Measuring tape
- Hammer (to drive probes)

Step 1. Install the 4 test probes in the ground equally spaced in a straight line. Generally the shorter spacing is done first (i.e. 1m).

Step 2. Using the conductors, connect the C_1, P_1, P_2 and C_2 terminals to the electrodes. The electrodes must be connected in order from the end, to the C_1, P_1, P_2 and C_2 terminals.

Step 3. Press the test button and read the digital display. Record the reading on the memory of the tester.

Step 5. Place the probes at each of the spacing indicated above and record the readings.

6.4.3 CORROSIVENESS OF SOIL

The corrosiveness of the soil is dependent on the resistance it offers to the flow of charges, lower the resistance higher the conductivity and consequently higher corrosiveness of the soil due to ease of charge flow. *Table 6.2* gives generic values of ground resistance against corrosiveness.

The values of ground resistance for all the readings are greater than 100 Ωm and the ground conditions up to 5m depth below existing ground level can be classified as *generally not corrosive*.

Table 6.2 Resistivity versus Corrosiveness of Soil

Corrosivity	Resistivity (Ωm)
Very Corrosive	Below 5
Corrosive	5-10
Moderately Corrosive	10-20
Mildly Corrosive	20-100
Generally not Corrosive	> 100

7. CONCLUSIONS

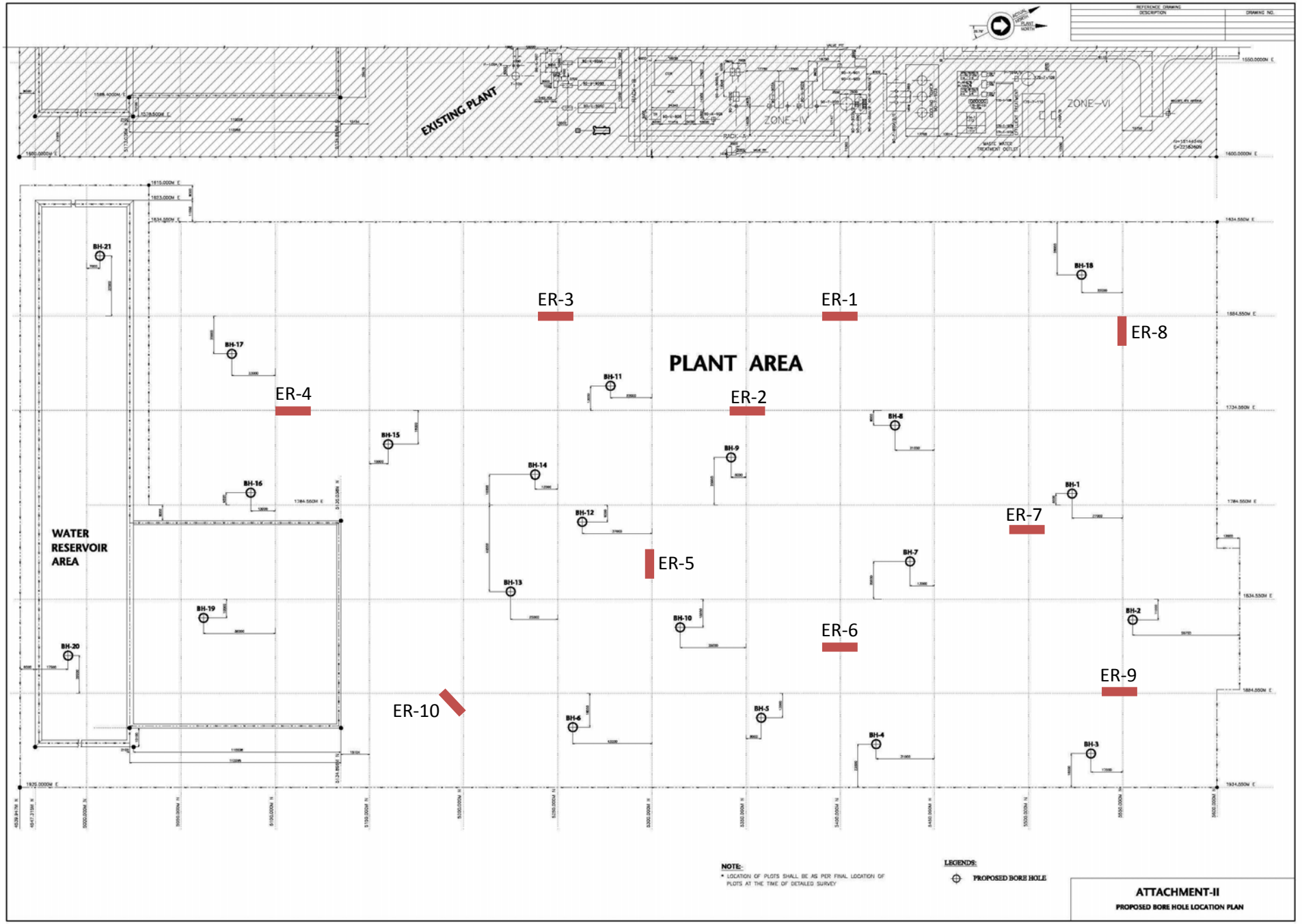
Geotechnical Investigation for UCH-II Development Project, Dera Bugti was carried out in the period of December 2011 to January 2012. Twenty-five boreholes were drilled and ten electrical resistivity tests were carried out as part of the field investigation. Soil and samples were also collected during the field investigation. Laboratory testing of these samples has been carried out in the lab and includes determination of index properties through grain-size analysis, Atterberg limits, density and specific gravity tests. Shearing characteristics of the soil samples has also been determined through direct shear tests and unconfined compression tests. Chemical characteristics of soil samples have also been assessed through determination of total dissolved solids, sulphate content, chloride content and pH.

Keeping in view the results from field and laboratory tests on soil samples and the expected loads being transferred to the founding stratum, allowable bearing pressures have been recommended for isolated and raft footings. Non-aggressive chemical characteristics of the subsurface soil mean that *Ordinary Portland Cement (OPC)* should be used for underground concreting.

The corrosiveness of the ground up to 5 meters below existing ground has been determined through electrical resistivity tests and very high resistivity values indicate non-corrosiveness of the subsurface deposits.

Appendix A

Boreholes Location Plan


EXISTING PLANT
ZONE-IV
ZONE-VI
PLANT AREA
WATER RESERVOIR AREA
ER-1
ER-2
ER-3
ER-4
ER-5
ER-6
ER-7
ER-8
ER-9
ER-10
BH-1
BH-2
BH-3
BH-4
BH-5
BH-6
BH-7
BH-8
BH-9
BH-10
BH-11
BH-12
BH-13
BH-14
BH-15
BH-16
BH-17
BH-18
BH-19
BH-20
BH-21
NOTE:
* LOCATION OF PLOTS SHALL BE AS PER FINAL LOCATION OF PLOTS AT THE TIME OF DETAILED SURVEY
LEGENDS:
PROPOSED BORE HOLE
ATTACHMENT-II
PROPOSED BORE HOLE LOCATION PLAN

Appendix B

Borehole Logs

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: December 23, 2011 End date: December 23, 2011		Casing diameter: -	BOREHOLE No. BH-1
Drilling Method: Rotary Wash Equipment:		Borehole Diameter: 100 mm	Ground level: Natural surface level
Driller: Mr. Zafar			Water Table Not encountered

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
23.12.11 8:00 AM	N/A	N/E	1	SPT	1	27	450	**Brown, medium dense, silty fine SAND**		
8:50 AM			2	SPT	2	24	450			
9:35 AM			3	SPT	3	40	450			
10:25 AM			4	SPT	4	20	450			
11:05 AM			5	SPT	5	28	450	**Brown, medium dense, dense to very dense, silty fine SAND, interlayer with coarse sand at places**		
11:50 AM			6	SPT	6	39	450			
12:40 PM			7	SPT	7	47	450			
1:40 PM			8	SPT	8	Refusal	100			
3:10 PM			9	SPT	9	Refusal	100			
4:00 PM			10	SPT	10	Refusal	100	**Bottom of BH-1 at 10-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: December 29, 2011 End date: December 29, 2011		Casing diameter: -	BOREHOLE No. BH-2
Drilling Method: Rotary Wash Equipment:		Borehole Diameter: 100 mm	Ground level: Natural surface level
Driller: Mr. Zafar			Water Table Not encountered

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
29.12.11			1							
9:00 AM				SPT	1	33	450			
			2					Yellowish brown, medium dense, silty fine SAND with interlayer of fine gravel at places		
9:40 AM				SPT	2	25	450			
			3							
10:50 AM				SPT	3	24	450			
			4							
11:30 AM				SPT	4	29	450			
	N/A	N/E	5							
1:15 PM				SPT	5	30	450			
			6							
2:00 PM				SPT	6	33	450			
			7					Yellowish brown, dense to very dense, silty fine SAND with coarse sand at places		
2:35 PM				SPT	7	39	450			
			8							
			9							
3:20 PM				SPT	8	43	450			
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	M. Ali Bilgrami/F. Abbas
Compiled by:	Syed Irfan Shah
Checked by:	Ali Zaidi

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	KGI-2011-268
Sheet No.	1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 29, 2011** End date: **December 29, 2011**		Casing diameter: **-**	BOREHOLE No. **BH-2**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level**
Driller: **Mr. Zafar**			Water Table **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Sample details: Type	Sample details: No.	Standard Penetration Test: Blows/N	Standard Penetration Test: Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
29.12.11										
4:25 PM			11	SPT	9	Refusal	100			
5:10 PM	N/A	N/E	12	SPT	10	Refusal	100	**Yellowish brown, dense to very dense, silty fine SAND with coarse sand at places**		
5:35 PM			13	SPT	11	Refusal	100			
5:55 PM			14	SPT	12	Refusal	100			
			15					**Bottom of BH-2 at 15-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 26, 2011** End date: **December 26, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-3**
Drilling Method: **Rotary Wash** Equipment: Driller: **Mr. Zafar**	Borehole Diameter: **100 mm**	Ground level: Water Table	**Natural surface level** **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
26.12.11 9:10 AM	N/A	N/E	1	SPT	1	21	450	**Yellowish brown, medium dense, silty fine SAND**		
10:00 AM			2	SPT	2	25	450			
10:35 AM			3	SPT	3	29	450	**Yellowish brown, medium dense, silty medium coarse SAND**		
11:15 AM			4	SPT	4	28	450			
12:00 PM			5	SPT	5	30	450			
12:40 PM			6	SPT	6	29	450			
1:15 PM			7	SPT	7	43	450	**Yellowish brown, dense to very dense, silty fine to medium coarse SAND**		
2:00 PM			8	SPT	8	Refusal	100			
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	**M. Ali Bilgrami/F. Abbas**
Compiled by:	**Syed Irfan Shah**
Checked by:	**Ali Zaidi**

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	**KGI-2011-268**
Sheet No.	**1 of 1**

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 26, 2011** End date: **December 26, 2011**		Casing diameter: **-**	BOREHOLE No. **BH-3**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level** Water Table **Not encountered**
Driller: **Mr. Zafar**			

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
26.12.11										
2:35 PM			11	SPT	9	Refusal	100			
3:15 PM			12	SPT	10	Refusal	100	**Yellowish brown, dense to very dense, silty fine to medium coarse SAND**		
	N/A	**N/E**	13							
4:00 PM			14	SPT	11	Refusal	100			
4:40 PM			15	SPT	12	Refusal	100			
								Bottom of BH-3 at 15-meter		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 26, 2011** End date: **December 26, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-4**
Drilling Method: **Rotary Wash** Equipment:	Borehole Diameter: **100 mm**	Ground level:	**Natural surface level**
Driller: **Mr. Munir**		Water Table	**Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
26.12.11 9:20 AM	N/A	N/E	1	SPT	1	25	450	**Brown, medium dense to dense, silty fine SAND**		
10:10 AM			2	SPT	2	42	450			
10:45 AM			3	SPT	3	42	450			
11:30 AM			4	SPT	4	46	450			
12:15 PM			5	SPT	5	Refusal	100	**Brown, dense to very dense, silty fine SAND, interlayer coarse sand at places**		
12:55 PM			6	SPT	6	45	450			
2:10 PM			7	SPT	7	47	450			
2:50 PM			8	SPT	8	Refusal	100			
			9							
			10							

Remarks:

-	SPT	Standard Penetration Test
-	SPT(C)	Standard Penetration Test with Cone
-	UDS	Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 26, 2011** End date: **December 26, 2011**		Casing diameter: **-**	BOREHOLE No. **BH-4**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level** Water Table **Not encountered**
Driller: **Mr. Munir**			

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
26.12.11										
3:15 PM			11	SPT	9	Refusal	100			
4:10 PM	N/A	N/E	12	SPT	10	Refusal	100	**Brown, dense to very dense, silty fine SAND, interlayer coarse sand at places**		
4:55 PM			13	SPT	11	Refusal	100			
5:40 PM			14	SPT	12	Refusal	100			
			15					**Bottom of BH-4 at 15-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 27, 2011** End date: **December 27, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-5**
Drilling Method: **Rotary Wash** Equipment:	Borehole Diameter: **100 mm**	Ground level:	**Natural surface level**
Driller: **Mr. Munir**		Water Table	**Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
27.12.11 8:40 AM	N/A	N/E	1	SPT	1	18	450	**Brown, medium dense silty fine SAND**		
9:20 AM			2	SPT	2	22	450			
10:00 AM			3	SPT	3	24	450			
10:35 AM			4	SPT	4	30	450			
11:10 AM			5	SPT	5	35	100	**Brown, medium dense, dense to very dense, silty fine SAND, interlayer coarse sand at places**		
11:45 AM			6	SPT	6	40	450			
12:30 PM			7	SPT	7	47	450			
1:05 PM			8	SPT	8	Refusal	100			
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 27, 2011** End date: **December 27, 2011**		Casing diameter: **-**	BOREHOLE No. **BH-5**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level** Water Table **Not encountered**
Driller: **Mr. Munir**			

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
27.12.11 2:00 PM	N/A	N/E	11	SPT	9	Refusal	100	**Brown, medium dense, dense to very dense, silty fine SAND, interlayer coarse sand at places**		
2:25 PM			12	SPT	10	Refusal	100			
3:10 PM			13	SPT	11	Refusal	100			
4:05 PM			14 15	SPT	12	Refusal	100			
								Bottom of BH-5 at 15-meter		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

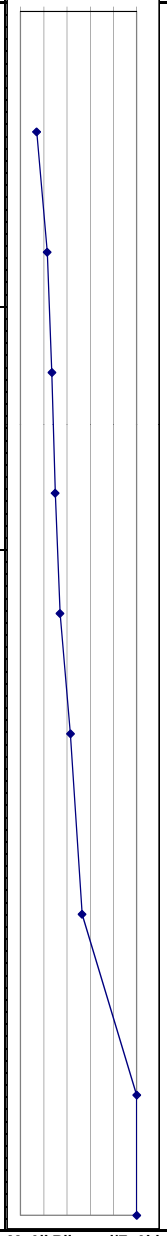
Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 28, 2011** End date: **December 28, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-6**
Drilling Method: **Rotary Wash** Equipment: Driller: **Mr. Zafar**	Borehole Diameter: **100 mm**	Ground level: Water Table	**Natural surface level** **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
28.12.11 9:10 AM	N/A	N/E	1	SPT	1	14	450	**Yellowish brown, medium dense, silty fine SAND with fine gravel at places**		
9:50 AM			2	SPT	2	23	450			
10:20 AM			3	SPT	3	27	450	**Yellowish brown, dense, silty fine SAND**		
11:10 AM			4	SPT	4	30	450			
12:00 PM			5	SPT	5	34	100	**Yellowish brown, dense to very dense, silty fine SAND with coarse sand at places**		
1:00 PM			6	SPT	6	43	450			
1:45 PM			7	SPT	7	53	450			
2:30 PM			8	SPT	8	Refusal	100			
			9							
			10							



Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	**M. Ali Bilgrami/F. Abbas**
Compiled by:	**Syed Irfan Shah**
Checked by:	**Ali Zaidi**

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	**KGI-2011-268**
Sheet No.	**1 of 1**

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 28, 2011** End date: **December 28, 2011**		Casing diameter: **-**	BOREHOLE No. **BH-6**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level**
Driller: **Mr. Zafar**			Water Table **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
28.12.11 3:10 PM	N/A	N/E	11	SPT	9	Refusal	100	**Yellowish brown, dense to very dense, silty fine SAND with coarse sand at places**		
3:55 PM			12	SPT	10	Refusal	100			
4:35 PM			13	SPT	11	Refusal	100			
5:05 PM			14 15	SPT	12	Refusal	100			
								Bottom of BH-6 at 15-meter		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 30, 2011** End date: **December 30, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-7**
Drilling Method: **Rotary Wash** Equipment:	Borehole Diameter: **100 mm**	Ground level:	**Natural surface level**
Driller: **Mr. Zafar**		Water Table	**Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
30.12.11 8:35 AM	N/A	N/E	1	SPT	1	16	450	**Yellowish brown, medium dense to dense, silty fine SAND with interlayer of fine gravel at places**		
9:20 AM			2	SPT	2	17	450			
10:10 AM			3	SPT	3	20	450			
11:00 AM			4	SPT	4	23	450			
11:40 AM			5	SPT	5	34	100			
12:15 PM			6	SPT	6	30	450			
12:50 PM			7	SPT	7	40	450	**Yellowish brown, dense to very dense, silty fine SAND**		
1:45 PM			8	SPT	8	47	100			
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	**M. Ali Bilgrami/F. Abbas**
Compiled by:	**Syed Irfan Shah**
Checked by:	**Ali Zaidi**

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	**KGI-2011-268**
Sheet No.	**1 of 1**

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 30, 2011** End date: **December 30, 2011**		Casing diameter: **-**	BOREHOLE No. **BH-7**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level** Water Table **Not encountered**
Driller: **Mr. Zafar**			

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
30.12.11										
2:30 PM			11	SPT	9	Refusal	100			
3:35 PM			12	SPT	10	Refusal	100	**Yellowish brown, dense to very dense, silty fine SAND**		
	N/A	**N/E**	13							
4:25 PM			14	SPT	11	Refusal	100			
5:10 PM			15	SPT	12	Refusal	100			
								Bottom of BH-7 at 15-meter		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 30, 2011** End date: **December 30, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-8**
Drilling Method: **Rotary Wash** Equipment: Driller: **Mr. Zafar**	Borehole Diameter: **100 mm**	Ground level: Water Table	**Natural surface level** **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
30.12.11 8:10 AM	N/A	N/E	1	SPT	1	25	450	**Yellowish brown, medium dense, silty fine SAND**		
8:45 AM			2	SPT	2	29	450			
9:15 AM			3	SPT	3	36	450	**Yellowish brown, dense to very dense, silty fine SAND with interlayer of coarse sand, trace little gravel at place**		
10:00 AM			4	SPT	4	42	450			
10:30 AM			5	SPT	5	49	100			
11:05 AM			6	SPT	6	Refusal	100			
11:30 AM			7	SPT	7	Refusal	100			
12:10 PM			8	SPT	8	Refusal	100	**Yellowish brown, very dense, silty fine SAND**		
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 30, 2011** End date: **December 30, 2011**		Casing diameter: **-**	BOREHOLE No. **BH-8**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level**
Driller: **Mr. Zafar**			Water Table **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
30.12.11										
1:00 PM			11	SPT	9	Refusal	100			
1:40 PM			12	SPT	10	Refusal	100	**Yellowish brown, very dense, silty fine SAND**		
	N/A	**N/E**	13							
2:30 PM			14	SPT	11	Refusal	100			
3:20 PM			15	SPT	12	Refusal	100			
								Bottom of BH-8 at 15-meter		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 31, 2011** End date: **December 31, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-9**
Drilling Method: **Rotary Wash** Equipment: Driller: **Mr. Zafar**	Borehole Diameter: **100 mm**	Ground level: Water Table	**Natural surface level** **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
31.12.11 9:10 AM	**N/A**	**N/E**	1	SPT	1	22	450	**Yellowish brown, medium dense, silty fine SAND**		
9:50 AM			2	SPT	2	27	450			
10:35 AM			3	SPT	3	80	450	**Yellowish brown, very dense, silty fine SAND with interlayer of coarse sand**		
11:05 AM			4	SPT	4	80	450			
11:35 AM			5	SPT	5	89	100			
12:15 PM			6	SPT	6	Refusal	100			
12:55 PM			7	SPT	7	Refusal	100			
1:40 PM			8	SPT	8	Refusal	100	**Yellowish brown, very dense, silty fine SAND**		
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 31, 2011** End date: **December 31, 2011**		Casing diameter: **-**	BOREHOLE No. **BH-9**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level**
Driller: **Mr. Zafar**			Water Table **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Sample details: Type	Sample details: No.	Standard Penetration Test: Blows/N	Standard Penetration Test: Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
31.12.11 2:40 PM	N/A	N/E	11	SPT	9	Refusal	100	**Yellowish brown, very dense, silty fine SAND**		
3:25 PM			12	SPT	10	Refusal	100			
4:25 PM			13	SPT	11	Refusal	100			
5:10 PM			14	SPT	12	Refusal	100			
			15					**Bottom of BH-9 at 15-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 31, 2011** End date: **December 31, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-10**
Drilling Method: **Rotary Wash** Equipment: Driller: **Mr. Zafar**	Borehole Diameter: **100 mm**	Ground level: Water Table	**Natural surface level** **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
31.12.11 8:25 AM	**N/A**	**N/E**	1	SPT	1	14	450	**Yellowish brown, medium dense to dense, silty fine SAND with interlayer of coarse sand**		
9:10 AM			2	SPT	2	22	450			
9:45 AM			3	SPT	3	28	450			
10:20 AM			4	SPT	4	34	450			
11:00 AM			5	SPT	5	33	450			
11:35 AM			6	SPT	6	43	450			
12:15 PM			7	SPT	7	Refusal	100	**Yellowish brown, very dense, silty fine SAND**		
1:00 PM			8	SPT	8	Refusal	100			
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	**M. Ali Bilgrami/F. Abbas**
Compiled by:	**Syed Irfan Shah**
Checked by:	**Ali Zaidi**

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	**KGI-2011-268**
Sheet No.	**1 of 1**

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 31, 2011** End date: **December 31, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-10**
Drilling Method: **Rotary Wash** Equipment: Driller: **Mr. Zafar**	Borehole Diameter: **100 mm**	Ground level: Water Table	**Natural surface level** **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
31.12.11 1:40 PM	N/A	N/E	11	SPT	9	Refusal	100			
2:20 PM			12	SPT	10	Refusal	100	**Yellowish brown, very dense, silty fine SAND**		
3:00 PM			13	SPT	11	Refusal	100			
3:45 PM			14 15	SPT	12	Refusal	100			
								Bottom of BH-10 at 15-meter		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	**M. Ali Bilgrami/F. Abbas**
Compiled by:	**Syed Irfan Shah**
Checked by:	**Ali Zaidi**

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	**KGI-2011-268**
Sheet No.	**1 of 1**

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 24, 2011** End date: **December 24, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-11**
Drilling Method: **Rotary Wash** Equipment:	Borehole Diameter: **100 mm**	Ground level:	**Natural surface level**
Driller: **Mr. Munir**		Water Table	**Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
24.12.11 8:50 AM	N/A	N/E	1	SPT	1	12	450	**Yellowish brown, medium dense, silty fine SAND**		
9:40 AM			2	SPT	2	18	450			
10:10 AM			3	SPT	3	25	450			
10:45 AM			4	SPT	4	30	450			
11:20 AM			5	SPT	5	19	450	**Yellowish brown, medium dense, silty fine to medium coarse SAND**		
12:00 PM			6	SPT	6	21	450			
12:30 PM			7	SPT	7	39	450	**Yellowish brown, dense to very dense, silty fine to coarse SAND**		
1:15 PM			8	SPT	8	Refusal	100			
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	**M. Ali Bilgrami/F. Abbas**
Compiled by:	**Syed Irfan Shah**
Checked by:	**Ali Zaidi**

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	**KGI-2011-268**
Sheet No.	**1 of 1**

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 24, 2011** End date: **December 24, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-11**
Drilling Method: **Rotary Wash** Equipment: Driller: **Mr. Munir**	Borehole Diameter: **100 mm**	Ground level: Water Table	**Natural surface level** **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
24.12.11										
1:50 PM			11	SPT	9	Refusal	100	**Yellowish brown, dense to very dense, silty fine to coarse SAND**		
2:35 PM	**N/A**	**N/E**	12	SPT	10	Refusal	100			
			13					**Yellowish brown, very dense, silty fine SAND**		
3:10 PM			14	SPT	11	Refusal	100			
3:55 PM			15	SPT	12	Refusal	100			
								Bottom of BH-11 at 15-meter		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 01, 2012** End date: **January 01, 2012**		Casing diameter: **-**	BOREHOLE No. **BH-12**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level**
Driller: **Mr. Zafar**			Water Table **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
01.01.12 9:10 AM	N/A	N/E	1	SPT	1	13	450	**Yellowish brown, medium dense, silty fine SAND little fine gravel**		
9:50 AM			2	SPT	2	28	450			
10:30 AM			3	SPT	3	32	450	**Yellowish brown, dense, silty fine SAND**		
11:15 AM			4	SPT	4	31	450			
12:05 PM			5	SPT	5	48	450	**Yellowish brown, very dense, silty fine to medium SAND**		
12:45 PM			6	SPT	6	55	450			
1:35 PM			7	SPT	7	58	450			
2:25 PM			8	SPT	8	56	450			
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 01, 2012** End date: **January 01, 2012**		Casing diameter: **-**	BOREHOLE No. **BH-12**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level**
Driller: **Mr. Zafar**			Water Table **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Sample details: Type	Sample details: No.	Standard Penetration Test: Blows/N	Standard Penetration Test: Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
01.01.12 3:30 PM	N/A	N/E	11	SPT	9	Refusal	100			
4:00 PM			12	SPT	10	Refusal	100	**Yellowish brown, very dense, silty fine to medium SAND**		
4:40 PM			13	SPT	11	Refusal	100			
5:10 PM			14	SPT	12	Refusal	100			
			15					**Bottom of BH-12 at 15-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 01, 2012** End date: **January 01, 2012**		Casing diameter: **-**	BOREHOLE No. **BH-13**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level**
Driller: **Mr. Zafar**			Water Table **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
01.01.12 8:20 AM	N/A	N/E	1	SPT	1	21	450	**Yellowish brown, medium dense, silty fine SAND little fine gravel**		
9:00 AM			2	SPT	2	27	450			
9:40 AM			3	SPT	3	24	450	**Yellowish brown, dense to very dense, silty fine to medium SAND**		
10:15 AM			4	SPT	4	31	450			
10:55 AM			5	SPT	5	33	450			
11:30 AM			6	SPT	6	40	450			
12:15 PM			7	SPT	7	43	450			
1:05 PM			8	SPT	8	46	450			
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 01, 2012** End date: **January 01, 2012**	Casing diameter: **-**	BOREHOLE No.	**BH-13**
Drilling Method: **Rotary Wash** Equipment:	Borehole Diameter: **100 mm**	Ground level:	**Natural surface level**
Driller: **Mr. Zafar**		Water Table	**Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Sample details: Type	Sample details: No.	Standard Penetration Test: Blows/N	Standard Penetration Test: Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
01.01.12 1:50 PM	N/A	N/E	11	SPT	9	Refusal	100	**Yellowish brown, dense to very dense, silty fine to medium SAND**		
2:40 PM			12	SPT	10	Refusal	100			
			13							
3:35 PM			14	SPT	11	Refusal	100			
4:20 PM			15	SPT	12	Refusal	100			
								Bottom of BH-13 at 15-meter		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 02, 2012** End date: **January 02, 2012**	Casing diameter: **-**	BOREHOLE No.	**BH-14**
Drilling Method: **Rotary Wash** Equipment: Driller: **Mr. Zafar**	Borehole Diameter: **100 mm**	Ground level: Water Table	**Natural surface level** **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
02.01.12 8:10 AM	N/A	N/E	1	SPT	1	21	450	**Yellowish brown, medium dense, silty fine SAND little fine gravel**		
8:45 AM			2	SPT	2	26	450			
9:20 AM			3	SPT	3	32	450			
10:00 AM			4	SPT	4	35	450			
10:35 AM			5	SPT	5	46	450	**Yellowish brown, dense to very dense, silty fine SAND**		
11:05 AM			6	SPT	6	64	450			
11:40 AM			7	SPT	7	62	450			
12:15 PM			8	SPT	8	67	450			
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 02, 2012** End date: **January 02, 2012**		Casing diameter: **-**	BOREHOLE No. **BH-14**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level**
Driller: **Mr. Zafar**			Water Table **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
01.01.12 12:40 PM	N/A	N/E	11	SPT	9	Refusal	100	**Yellowish brown, dense to very dense, silty fine SAND**		
1:00 PM			12	SPT	10	Refusal	100			
			13							
1:30 PM			14	SPT	11	Refusal	100			
2:00 PM			15	SPT	12	Refusal	100			
								Bottom of BH-14 at 15-meter		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 04, 2012** End date: **January 04, 2012**	Casing diameter: **-**	BOREHOLE No.	**BH-15**
Drilling Method: **Rotary Wash** Equipment:	Borehole Diameter: **100 mm**	Ground level:	**Natural surface level**
Driller: **Mr. Zafar**		Water Table	**Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
04.01.12 7:55 AM	N/A	N/E	1	SPT	1	29	450	**Yellowish brown, medium dense to dense, silty fine SAND with little fine gravel (rounded to sub angular)**		
8:25 AM			2	SPT	2	33	450			
9:05 AM			3	SPT	3	36	450			
9:35 AM			4	SPT	4	40	450	**Yellowish brown, very dense, silty fine to medium coarse SAND**		
10:15 AM			5	SPT	5	52	450			
10:45 AM			6	SPT	6	Refusal	100			
11:10 AM			7	SPT	7	Refusal	100	**Yellowish brown, very dense, silty fine SAND**		
11:40 AM			8	SPT	8	Refusal	100			
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	**M. Ali Bilgrami/F. Abbas**
Compiled by:	**Syed Irfan Shah**
Checked by:	**Ali Zaidi**

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	**KGI-2011-268**
Sheet No.	**1 of 1**

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 04, 2012** End date: **January 04, 2012**		Casing diameter: **-**	BOREHOLE No. **BH-15**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level**
Driller: **Mr. Zafar**			Water Table **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Sample details: Type	Sample details: No.	Standard Penetration Test: Blows/N	Standard Penetration Test: Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
04.01.12 12:30 PM	N/A	N/E	11	SPT	9	Refusal	100			
12:55 PM			12	SPT	10	Refusal	100	**Yellowish brown, very dense, silty fine SAND**		
1:30 PM			13	SPT	11	Refusal	100			
2:15 PM			14	SPT	12	Refusal	100			
			15					**Bottom of BH-15 at 15-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 03, 2012** End date: **January 03, 2012**	Casing diameter: **-**	BOREHOLE No.	**BH-16**
Drilling Method: **Rotary Wash** Equipment: Driller: **Mr. Zafar**	Borehole Diameter: **100 mm**	Ground level: Water Table	**Natural surface level** **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
03.01.12 9:10 AM	N/A	N/E	1	SPT	1	36	450	**Yellowish brown, medium dense to dense, silty fine SAND with little fine gravel (rounded to sub angular)**		
9:35 AM			2	SPT	2	22	450			
10:15 AM			3	SPT	3	21	450			
11:00 AM			4	SPT	4	23	450			
11:40 AM			5	SPT	5	28	450			
12:35 PM			6	SPT	6	33	100	**Yellowish brown, medium dense to very dense, silty fine SAND**		
1:30 PM			7	SPT	7	38	100			
2:15 PM			8	SPT	8	48	100			
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 03, 2012** End date: **January 03, 2012**		Casing diameter: **-**	BOREHOLE No. **BH-16**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level**
Driller: **Mr. Zafar**			Water Table **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
04.01.12 3:05 PM	N/A	N/E	11	SPT	9	51	100			
3:50 PM			12	SPT	10	Refusal	100	**Yellowish brown, medium dense to very dense, silty fine SAND**		
4:40 PM			13	SPT	11	Refusal	100			
5:25 PM			14	SPT	12	Refusal	100			
			15					**Bottom of BH-16 at 15-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 25, 2011** End date: **December 25, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-17**
Drilling Method: **Rotary Wash** Equipment:	Borehole Diameter: **100 mm**	Ground level:	**Natural surface level**
Driller: **Mr. Munir**		Water Table	**Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
25.12.11 9:15 AM	N/A	N/E	1	SPT	1	26	450	**Yellowish brown, medium dense, silty fine SAND**		
9:55 AM			2	SPT	2	28	450			
10:35 AM			3	SPT	3	26	450	**Yellowish brown, medium dense to dense, silty fine SAND with interlayer of coarse sand at places**		
11:10 AM			4	SPT	4	30	450			
11:45 AM			5	SPT	5	30	450			
12:25 PM			6	SPT	6	20	100			
1:05 PM			7	SPT	7	38	100	**Yellowish brown, very dense, silty fine SAND with interlayer of coarse sand at places**		
1:45 PM			8	SPT	8	Refusal	100			
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	**M. Ali Bilgrami/F. Abbas**
Compiled by:	**Syed Irfan Shah**
Checked by:	**Ali Zaidi**

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	**KGI-2011-268**
Sheet No.	**1 of 1**

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 25, 2011** End date: **December 25, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-17**
Drilling Method: **Rotary Wash** Equipment:	Borehole Diameter: **100 mm**	Ground level:	**Natural surface level**
Driller: **Mr. Munir**		Water Table	**Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
25.12.11 2:10 PM			11	SPT	9	Refusal	100			
3:00 PM	**N/A**	**N/E**	12	SPT	10	Refusal	100	**Yellowish brown, very dense, silty fine SAND with interlayer of coarse sand at places**		
3:30 PM			13	SPT	11	Refusal	100			
4:20 PM			14	SPT	12	Refusal	100			
			15					**Bottom of BH-17 at 15-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 23, 2011** End date: **December 23, 2011**		Casing diameter: **-**	BOREHOLE No. **BH-18**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level** Water Table **Not encountered**
Driller: **Mr. Zafar**			

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
23.12.11 8:20 AM	N/A	N/E	1	SPT	1	18	450	**Top Soil** **Yellowish brown, medium dense to dense, silty fine SAND with interlayer of coarse sand**		
9:00 AM			2	SPT	2	30	450			
9:35 AM			3	SPT	3	16	450			
10:20 AM			4	SPT	4	18	450			
11:00 AM			5	SPT	5	50	450			
11:40 AM			6	SPT	6	Refusal	100	**Yellowish brown, very dense, very coarse SAND**		
12:15 PM			7	SPT	7	Refusal	100	**Yellowish brown, very dense, silty fine to medium coarse SAND with interbedded of clay**		
1:10 PM			8	SPT	8	Refusal	100			
2:20 PM			9	SPT	9	Refusal	100			
3:30 PM			10	SPT	10	Refusal	100	**Bottom of BH-18 at 10-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 04, 2012** End date: **January 04, 2012**	Casing diameter: **-**	BOREHOLE No.	**BH-19**
Drilling Method: **Rotary Wash** Equipment:	Borehole Diameter: **100 mm**	Ground level:	**Natural surface level**
Driller: **Mr. Zafar**		Water Table	**Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
04.01.12 8:15 AM	N/A	N/E	1	SPT	1	32	450	**Yellowish brown, medium dense to dense, silty fine to medium coarse SAND**		
8:55 AM			2	SPT	2	25	450			
9:20 AM			3	SPT	3	44	450	**Yellowish brown, dense, silty SAND/sandy SILT**		
10:00 AM			4	SPT	4	49	450			
10:35 AM			5	SPT	5	71	450	**Yellowish brown, very dense, silty fine SAND with interlayer of coarse SAND**		
11:10 AM			6	SPT	6	Refusal	100			
12:00 PM			7	SPT	7	Refusal	100			
12:45 PM			8	SPT	8	Refusal	100	**Yellowish brown, very dense, silty fine SAND**		
			9							
			10							

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	**M. Ali Bilgrami/F. Abbas**
Compiled by:	**Syed Irfan Shah**
Checked by:	**Ali Zaidi**

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	**KGI-2011-268**
Sheet No.	**1 of 1**

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 04, 2012** End date: **January 04, 2012**		Casing diameter: **-**	BOREHOLE No. **BH-19**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level**
Driller: **Mr. Zafar**			Water Table **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
04.01.12 1:25 PM	N/A	N/E	11	SPT	9	Refusal	100			
2:20 PM			12	SPT	10	Refusal	100	**Yellowish brown, very dense, silty fine SAND**		
3:00 PM			13	SPT	11	Refusal	100			
3:45 PM			14	SPT	12	Refusal	100			
			15					**Bottom of BH-19 at 15-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 03, 2012** End date: **January 03, 2012**		Casing diameter: **-**	BOREHOLE No. **BH-20**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level** Water Table **Not encountered**
Driller: **Mr. Zafar**			

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
03.01.12 8:30 AM	N/A	N/E	1	SPT	1	14	450	**Top Soil** **Yellowish brown, medium dense, silty fine SAND with interlayer of coarse SAND**		
9:10 AM			2	SPT	2	17	450			
9:50 AM			3	SPT	3	16	450			
10:40 AM			4	SPT	4	23	450			
11:15 AM			5	SPT	5	34	450	**Yellowish brown, dense, silty fine SAND**		
12:00 PM			6	SPT	6	50	450			
12:45 PM			7	SPT	7	Refusal	125	**Yellowish brown, very dense, silty SAND/sandy SILT**		
1:30 PM			8							
2:15 PM			9	SPT	8	Refusal	100			
3:00 PM			10	SPT	9	Refusal	100	**Bottom of BH-20 at 10-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: M. Ali Bilgrami/F. Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **December 25, 2011** End date: **December 25, 2011**	Casing diameter: **-**	BOREHOLE No.	**BH-21**
Drilling Method: **Rotary Wash** Equipment: Driller: **Mr. Zafar**	Borehole Diameter: **100 mm**	Ground level: Water Table	**Natural surface level** **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
25.12.11 9:30 AM	**N/A**	**N/E**	1	SPT	1	22	450	**Brown, medium dense, silty fine SAND**		
10:15 AM			2	SPT	2	30	450			
11:00 AM			3	SPT	3	37	450			
11:50 AM			4	SPT	4	38	450			
12:45 PM			5	SPT	5	36	450			
1:30 PM			6	SPT	6	33	450	**Brown, dense to very dense, silty fine SAND, interlayer coarse sand at places**		
2:35 PM			7	SPT	7	39	450			
3:45 PM			8	SPT	8	Refusal	125			
4:10 PM			9	SPT	9	Refusal	100			
5:10 PM			10	SPT	10	Refusal	125	**Bottom of BH-21 at 10-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	**M. Ali Bilgrami/F. Abbas**
Compiled by:	**Syed Irfan Shah**
Checked by:	**Ali Zaidi**

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	**KGI-2011-268**
Sheet No.	**1 of 1**

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 05, 2012** End date: **January 05, 2012**	Casing diameter: **-**	BOREHOLE No.	**BH-1 (Well-27)**
Drilling Method: **Rotary Wash** Equipment: Driller: **Mr. Zafar**	Borehole Diameter: **100 mm**	Ground level: Water Table	**Natural surface level** **Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
05.01.12 9:30 AM	N/A	N/E	1	SPT	1	21	450	**Top Soil** **Yellowish brown, hard, clayey SILT**		
10:10 AM			2	SPT	2	53	450			
11:00 AM			3	SPT	3	Refusal	100			
11:40 AM			4	SPT	4	Refusal	100			
12:15 PM			5	SPT	5	Refusal	100			
12:55 PM			6	SPT	6	Refusal	100			
1:45 PM			7	SPT	7	Refusal	100			
2:50 PM			8							
3:30 PM			9	SPT	8	Refusal	100			
4:10 PM			10	SPT	9	Refusal	100	**Bottom of BH-1 at 10-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	**Fazal Abbas**
Compiled by:	**Syed Irfan Shah**
Checked by:	**Ali Zaidi**

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	**KGI-2011-268**
Sheet No.	**1 of 1**

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 06, 2012** End date: **January 06, 2012**	Casing diameter: **-**	BOREHOLE No.	**BH-2 (Well-20)**
Drilling Method: **Rotary Wash** Equipment:	Borehole Diameter: **100 mm**	Ground level:	**Natural surface level**
Driller: **Mr. Zafar**		Water Table	**Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
06.01.12 9:45 AM	N/A	N/E	1	SPT	1	17	450	**Yellowish brown, medium dense, silty fine to medium coarse SAND**		
10:25 AM			2	SPT	2	20	450			
10:50 AM			3	SPT	3	Refusal	100	**Yellowish brown, hard, clayey SILT**		
11:25 AM			4	SPT	4	Refusal	100			
12:00 PM			5	SPT	5	Refusal	100			
12:45 PM			6	SPT	6	Refusal	100			
1:30 PM			7	SPT	7	Refusal	100			
2:05 PM			8							
3:00 PM			9	SPT	8	Refusal	100			
3:40 PM			10	SPT	9	Refusal	100	**Bottom of BH-2 at 10-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	**Fazal Abbas**
Compiled by:	**Syed Irfan Shah**
Checked by:	**Ali Zaidi**

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	**KGI-2011-268**
Sheet No.	**1 of 1**

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 08, 2012** End date: **January 08, 2012**		Casing diameter: **-**	BOREHOLE No. **BH-3 (Well 29)**
Drilling Method: **Rotary Wash** Equipment:		Borehole Diameter: **100 mm**	Ground level: **Natural surface level** Water Table **Not encountered**
Driller: **Mr. Zafar**			

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
08.01.12 9:10 AM	N/A	N/E	1	SPT	1	16	450	**Greyish brown, medium dense, silty fine to medium SAND**		
9:45 AM			2	SPT	2	20	450			
10:25 AM			3	SPT	3	26	450			
11:00 AM			4	SPT	4	34	450			
11:35 AM			5	SPT	5	44	450			
1:05 PM			6	SPT	6	41	450	**Greyish brown, very dense, silty fine to medium SAND**		
1:45 PM			7	SPT	7	55	450			
2:50 PM			8							
3:45 PM			9	SPT	8	64	450			
4:40 PM			10	SPT	9	Refusal	100	**Bottom of BH-3 at 10-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by: Fazal Abbas
Compiled by: Syed Irfan Shah
Checked by: Ali Zaidi

Project : **Soil Investigation of the Site for UCH-II Development Project, Baluchistan**
Client : **ENAR Petrotech Services (Pvt) Limited**

Contract No. KGI-2011-268
Sheet No. 1 of 1

Soil Testing Services

SUBSURFACE EXPLORATION LOG

Start date: **January 07, 2012** End date: **January 07, 2012**	Casing diameter: **-**	BOREHOLE No.	**BH-4 (Well-30)**
Drilling Method: **Rotary Wash** Equipment:	Borehole Diameter: **100 mm**	Ground level:	**Natural surface level**
Driller: **Mr. Zafar**		Water Table	**Not encountered**

Time & date	Casing depth (m)	Depth to water (m)	Sample details: Depth (m)	Type	No.	Standard Penetration Test: Blows/N	Penetration (mm)	Description of strata	"N" Count Graph (0 20 40 60 80 100)	Legend
07.01.12 8:35 AM	N/A	N/E	1	SPT	1	17	450	**Dark brown, hard, clayey SILT**		
9:45 AM			2	SPT	2	20	450			
11:05 AM			3	SPT	3	Refusal	100			
11:50 AM			4	SPT	4	Refusal	100			
12:45 PM			5	SPT	5	Refusal	100			
1:40 PM			6	SPT	6	Refusal	100			
3:10 PM			7	SPT	7	Refusal	100			
4:10 PM			8	SPT	8	Refusal	100			
4:55 PM			9			CR%	RQD%			
5:30 PM			10	R	1	25	10	**Bottom of BH-4 at 10-meter**		

Remarks:

- SPT — Standard Penetration Test
- SPT(C) — Standard Penetration Test with Cone
- UDS — Undisturbed Sample

Logged by:	**Fazal Abbas**
Compiled by:	**Syed Irfan Shah**
Checked by:	**Ali Zaidi**

Project : Soil Investigation of the Site for UCH-II Development Project, Baluchistan
Client : ENAR Petrotech Services (Pvt) Limited

Contract No.	**KGI-2011-268**
Sheet No.	**1 of 1**