

PFC CONSULTING LIMITED

**(A wholly owned subsidiary of Power Finance Corporation Ltd. -
A Government of India Undertaking)**

ELECTRONIC TENDER DOCUMENT FOR TECHNICAL CONSULTANCY SERVICES

FOR

**Site Feasibility Study, Conducting various Technical Studies
& obtaining Environment Clearance for 2x660 MW Thermal
Power Project to be set up by Sangam Power Generation
Company Limited in the State of Uttar Pradesh**



(A wholly owned subsidiary of Power Finance Corporation Ltd.)

**Registered Office
1st Floor, "Urjanidhi"
1, Barakhamba Lane, Connaught Place,
New Delhi – 110 001**

October 3, 2018

PFC Consulting Ltd. invites E-Tenders for appointment of consulting organization for providing Consultancy Services for Site Feasibility Study, Conducting various Technical Studies & obtaining Environment Clearance for 2x660 MW Thermal Power Project to be set up by Sangam Power Generation Company Limited in the State of Uttar Pradesh

a)	Opening date of Tender downloading	3 October 2018 from 15:00 hrs (IST)
b)	Closing date of Tender downloading	18 October 2018 till 13:00 hrs (IST)
c)	Submission date of E-bids	18 October 2018 till 14:30 hrs (IST)
d)	Submission of Pass-Phrase to decrypt the Technical Bid-Part to PFCCL	18 October 2018 till 15:00 hrs (IST)
e)	Opening of E-bids	18 October at 15:00 hrs (IST)

Note: Tender Notice and Tender Document are available on PFC Consulting Ltd.'s website and can be downloaded from <https://www.pfclindia.com> or from the e-Tendering portal <https://www.tcil-india-electronictender.com>. For bid submission, the tenderer will have to necessarily download an official online copy of the tender documents from TCIL's e-portal. All future Information viz. corrigendum /addendum/ amendments etc. for this Tender shall be posted on the e-Tendering Portal only. Printed copy of Tender document will not be sold from PFC Consulting Ltd.'s office.

The bidder shall bear all costs associated with the preparation, submission/participation in the bid. Purchaser in no way will be responsible or liable for these costs regardless of the conduct or outcome of the bidding process.

Note: Bidders are advised to start the registration process on the <https://www.tcil-india-electronictender.com> as early as possible as it may take a few days so as to avoid any delay in bid submission (upload) stage.

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SECTION -1
BID INVITATION LETTER

BID INVITATION LETTER

Ref: 03/UP/Sangam/TC

October 3, 2018

To

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Sub: Sealed Bids for Consultancy Services for Site Feasibility Study, Conducting various Technical Studies & obtaining Environment Clearance for 2x660 MW Thermal Power Project to be set up by Sangam Power Generation Company Limited in the State of Uttar Pradesh

Sir,

PFC Consulting Limited (PFCCL) wishes to avail services of a Consulting Organization to assist PFCCL for carrying out **Site Feasibility Study, Conducting various Technical Studies & obtaining Environment Clearance for 2x660 MW Thermal Power Project to be set up by Sangam Power Generation Company Limited in the State of Uttar Pradesh (Assignment)**.

The Eligibility Criteria, Scope of Work, Deliverables, Selection Procedure and criteria, Terms of payment, Terms and conditions etc. are given below:

Sealed Bids are invited in single stage two envelop system (Technical bids & Price bids) for the Assignment.

1.0 Background

Sangam Power Generation Company Limited (SPGCL) was incorporated by UP Power Corporation Limited (UPPCL) on February 13, 2007 to execute Sangam Thermal Power Project at Tehsil Karchhana, District Allahabad, Uttar Pradesh, India in accordance with Competitive Bidding Guidelines for selection of a Successful Bidder to Build, Own, Operate and Maintain the Project.

Pursuant to the bidding process, Jaiprakash Associates Ltd. (JAL) was identified as the Selected Bidder. Jaiprakash Power Ventures Ltd. (An affiliate of JAL) purchased 100% share capital of the company as per said Guidelines.

UPPCL is in the Process of buying back SPGCL from Jaiprakash Power Ventures Ltd.

The Environment Clearance (EC) for the project was obtained earlier on 30 October 2009 and was valid for 5 years. The EC was extended by MoEF&CC till October 2018. Since the project could not be set up in above timeframe, the EC for the project is to be obtained again.

2.0 Scope of Work

The scope of the Assignment is to obtain Environment Clearance for the project inter alia including the following the following:

- i) Preparation of Pre-Feasibility Report (PFR) by carrying out site feasibility studies taking into consideration various factors but not limited to plant layout, land

availability for main plant, ash dyke, colony and ash pipeline corridor, coal transportation, approach to highways & railways, water source & availability, feasibility of transmission and grid connectivity, disturbance to the local population, R&R issues, environment and forest issues etc. The contents of the PFR shall be comprehensive enough and provide necessary information required for scoping the project and prescribing ToR for MoEF.

- ii) Preparation of Land Use Plan (Existing land use details) i.e., details of Land-use breakup of the lease area and study area should be based on land use - details of agricultural land, forest land, wasteland, grazing land, surface water bodies, settlements, etc
- iii) Preparation of layout plan indicating break-up of plant area, ash pond, area for green belt, infrastructure, roads etc.
- iv) Preparation of a map indicating the location of any National Park, Sanctuary, Elephant/Tiger Reserve (existing as well as proposed), migratory routes / wildlife corridor, if any, within 10 km of the project site etc as per guidelines of MOE&F .
- v) Topography of the study area supported by toposheet on 1:50,000 scale of Survey of India, alongwith a large scale map preferably of 1:25,000 scale and the specific information whether the site requires any filling shall be provided. In that case, details of filling, quantity of fill material required; its source, transportation, along with a contour map etc. shall be submitted.
- vi) Obtaining a Mineral map of the proposed site (including soil type) and information (if available) that the site is not located on economically feasible mineable mineral deposit.
- vii) Estimation of water requirement as per norms stipulated by CEA from time to time and preparation of water balance diagram. Details of water balance calculated shall take into account reuse and re-circulation of effluents which shall be explicitly specified. Feasibility of near zero discharge concept shall be critically examined and its details submitted.
- viii) Optimization of Cycles of Concentration (COC) along with other water conservation measures in the project shall be specified.
- ix) Carrying out water availability study, preparation of report as per norms stipulated by CEA from time to time and preparation of water balance diagram.
- x) Ash Utilization Plan as per requirement of MoEF guidelines including survey of cement plants, road projects, brick manufacturers etc, where ash could be utilized.
- xi) Submission of Rehabilitation and Resettlement (R&R) Plan and Corporate Social Responsibility (CSR) Plan based on applicable R&R Policy/CSR Policy for the Power Plant Land, Ash & Water Pipeline corridors, Fuel Transportation corridors, access roads etc.
- xii) Preparation of Pre-feasibility report, considering the above aspects and as per guidelines of Ministry of Environment and Forests (MoEF), Govt. of India and submission of application for Terms of Reference (TOR) to MoEF. The Consultant shall finalize the feasibility study by participating in meetings, discussions and furnishing further details etc. as may be necessary. The Consultant shall also provide other necessary documents and attending the meeting(s) of Expert Appraisal Committee (EAC) of MoEF and making presentation before EAC for obtaining TOR.

- xiii) Preparing and submitting the Rapid Environmental Impact Assessment (EIA) for Power Plant Land, Ash & Water Pipeline corridors and shall include necessary information on Environment Impact Assessment (EIA) and Environment Management Plan (EMP) shall need to be prepared.
- xiv) The Consultant's Scope includes Corridors Route survey for water and ash pipeline corridors
- xv) The Consultant's responsibility and liability also includes preparation of documents for Gram Sabhas, Public hearings and completing all activities to obtain NOC from State/District Authorities including State Pollution Control Board (SPCB) etc. Expediting the resolutions and minutes as the case may be.
- xvi) Carrying out technical studies for obtaining Hydrological, Geological, Meteorological and Seismological data etc. The various studies to be conducted includes: Area Drainage and Hydrology, General & Topographical Survey, Geo-technical Investigation etc.
- xvii) The Consultant has to prepare "Comprehensive Social Impact Assessment" and preparation of Rehabilitation and Resettlement (R&R) Plan and Corporate Social Responsibility (CSR) Plan through institutes like Tata Institute of Social Science (TISS), Xavier Institute of Social Science (XISS), XLRI etc or any other institute of similar repute.

The Consultant should carry out all the studies that would not be limited as per the specifications provided in the Bid document but as may be required additional for obtaining clearances/ approvals by MoEF and other concerned agencies/ Government instrumentalities.
- xviii) Further, the Consultant has to prepare all necessary reports including EIA and EMP; Common EIA (as may be required) etc; Cumulative Impact Assessment etc. on air, water and soil due to the proposed project and other industrial activity in existence or proposed in the area of 15 Kms radius of the project as per ToR or any other study to meet the requirement of MoEF for obtaining Environment Clearance.
- xix) Complying with all the requirements of TOR considered by MoEF as may be stipulated from time to time and also of other agencies till issuance of required Environmental Clearances/ approvals.
- xx) The Consultant's responsibility also includes preparation of Rehabilitation and Resettlement (R&R) Plan & Corporate Social Responsibility (CSR) plan and submission of the same to the concerned authorities and obtaining approval to the R&R and CSR plan from concerned authorities.
- xxi) Preparation, submission of application for statutory clearances from the Government instrumentality like Defence, Airports Authority or any other organization as may be required, subsequent follow up and obtaining clearances from such organizations.
- xxii) Based on above the Consultant shall prepare the Detailed Project Report (DPR) considering the standard practices adopted in civil, mechanical & electrical works. The DPR shall also include estimated cost of project with detailed break-up of various components and detailed analysis as well expected Tariff calculations, appropriate loan & equity mix, internal rate of return (IRR), interest on loan & interest during construction (IDC) and financial statements etc. The cost estimated should be prepared by considering the current practices adopted in industry and based on cost optimization.

- xxiii) The Consultant shall note that any comments tendered from PFCCL and/or Central Electricity Authority (CEA)/Other Statutory Organization or concerned Government instrumentality is to be incorporated before submitting the final Report.
- xxiv) Coordinating, following up, attending meeting(s)/conference(s), making presentations to the agencies/organizations/authorities, as may be required and desired by PFCCL, for obtaining clearances. Also, the Consultant would be required to interact, attend review meetings and make presentations to PFC Consulting Limited (PFCCL)/ MoEF, various departments of Govt. of Uttar Pradesh or any other agency at a time and place intimated by PFCCL.
- xxv) The Consultant will have to undertake all necessary studies as may be required as per the notification(s) issued by the MoEF during the execution of the assignment for obtaining Environmental clearance from MoEF.
- xxvi) Carrying out all related and/or incidental activities required for obtaining clearances/approvals for completion of the assignment.
- xxvii) Any other activities as intimated by PFCCL for successful completion of the assignment.

3.0 Deliverables

The firm is required to submit the following deliverables in line with the time schedule indicated against each deliverables. These time schedules may increase or decrease as required by PFCCL for completion of the assignment depending upon sequence of completion of interrelated activity.

SI. No.	Deliverables	Time Schedule <u>from the date of issue of LOA</u>
i)	Preparation of Pre-feasibility report, as per guidelines of Ministry of Environment and Forests (MoEF), Govt. of India	30 days
ii)	Submission of application for Terms of Reference (TOR) to the MoEF and obtaining TOR.	90 days
iii)	Preparing and submitting the Rapid Environmental Impact Assessment (EIA) for Power Plant Land, Ash & Water Pipeline corridors and shall include necessary information on Environment Impact Assessment (EIA) and Environment Management Plan (EMP) shall need to be prepared.	180 days
iv)	Application for Defense Clearance, Civil Aviation Clearance and other Statutory Clearances required for the project are to be filed with the appropriate authority.	180 days
v)	Public Hearing and completion of other activities and obtaining NOC from State Pollution Control Board (SPCB).	270 days

vi)	Submission and finalization of all other Reports like Cumulative Impact Assessment; Comprehensive Social Impact Assessment; Rehabilitation and Resettlement (R&R) Plan; Corporate Social Responsibility (CSR) Plan etc. and all other reports as per Guidelines of MoEF.	300 days
vii)	Submission of Detailed Project Report considering the standard practices adopted in civil, mechanical & electrical works and shall include estimated cost of project with detailed break-up of various components and detailed analysis as well expected Tariff calculations appropriate loan & equity mix, internal rate of return (IRR), interest on loan & interest during construction (IDC) and financial statements etc.	300 days
viii)	Application for Environment Clearance to SPCB/MoEF, as may be applicable.	300 days
ix)	Obtaining Environment Clearance and Other Statutory Clearances.	390 days

4.0 Qualifying Criteria

- 4.1 The Consulting Organization should be submitting the bid on its own and not in consortium with any other firm.
- 4.2 The Consulting Organization should be accredited with Quality Council of India (QCI) / National Accreditation Board of Education and Training (NABET).
- 4.3 The Consulting Organization should have cumulative Turnover of Rs. 5 Crores in immediate last three (03) financial years as per audited annual account. However if the firm is less than two year old minimum cumulative turnover of Rs. 3 Crores is required. The bidder should submit documentary proof in support of the turnover in the form of certificate, certified by Chartered Accountant
- 4.4 The Consulting Organization should have undertaken/ handled technical consultancy assignment for at least one Super Critical Coal fired Power Project which includes assistance to the Power Project developer in obtaining Terms of Reference (TOR) and Environmental Clearance (EC) from Ministry of Environment and Forests (MoEF) during last five (5) years i.e. period from Indian FY 2013-2014 onwards including the current Financial Year till date of issue of the tender.

The firm is required to submit the documentary evidence for meeting the above eligibility criteria as per the format enclosed at Form No.2

5.0 Contents of Bid Documents

The bid document contains the following documents.

Section -1 : Bid Invitation Letter

Section -2	:	Bid Forms and Performa
Section -3	:	Technical Specifications
Section-4	:	Contract Agreement

6.0 Period of Engagement

The period of engagement would be till the completion of the obligations of PFCCL to its client i.e till completion of the assignment.

7.0 Basis of Offer

The price offer for the Assignment should be quoted on a lump sum basis inclusive of all taxes and duties etc as may be applicable. No escalation for any reason whatsoever shall be allowed over and above the bid price. However, GST if any, shall be paid over and above the bid price (price to be quoted as per Form-6).

Income tax at source will be deducted by PFCCL as per the applicable law and regulation and TDS certificate shall be issued to the selected bidder by PFCCL.

8.0 Submission of Bid

8.1 Bid shall consist of two parts "**Technical Proposal**" and "**Financial Proposal**" and should be duly submitted online using the e-Procurement Portal <https://www.tcil-india-electronictender.com> before the due date. The last date for Bid submission (i.e. Bid Due date) online on e-Procurement Portal <https://www.tcil-india-electronictender.com> would be **18 October 2018 till 14:30 hrs (IST)**

Note:

- a. The Bidders should submit the copy of the valid accreditation certificate from Quality Council of India (QCI) / National Accreditation Board of Education and Training (NABET).
- b. The Technical Proposal should contain Form-1, Form-2, Form-3, Form-4, Form-5 and Form -7 duly filled and signed by authorized signatory and authority letter as per Form-5.
- c. The Bidder should agree to the entire scope of work and deliverables (given in the Covering Letter Form-1). No proposal for deviation/ part scope of work will be considered.
- d. Details of past experience are to be provided in Technical Bid as per format provided at Form-2.Documentary evidence (e.g. Copy of work Order/Letter of Award/Lol or any other representative documents etc. and proof of satisfactory completion for assignments handled from their Clients.) to be provided in support of past experience.
- e. Adequacy of the proposed Methodology and work Plan in responding to the Scope of Work as per Form - 7.

- f. Documentary proof in support of turnover shall be submitted by the Bidder in the form of certificate certified by Chartered Accountant.
- 8.2 The "FINANCIAL PROPOSAL" should contain the detailed price offer for the consultancy services as per as per format provided at Form-6 of Bid Document.
- 8.3 Bidders are instructed not to approach via e-mail, fax, and telephone or contact any official in PFCCCL as regards to this bid after the submission of the bids, apart from communications by PFCCCL in writing, and any bidder doing so shall be summarily rejected.

9.0 Bid Opening and Evaluation of Proposals

9.1 Opening of Technical Proposal

The "Technical Proposal" will be opened **on 18 October 2018 at 15:00 Hrs** in the presence of the authorized representatives of the agencies, who wish to be present.

9.1.1 Technical Proposal Evaluation

The Technical evaluation would be in two parts:

A. Completeness of bid with respect to the bidding document

- i) The Bidders should submit the copy of the valid accreditation certificate from Quality Council of India (QCI) / National Accreditation Board of Education and Training (NABET).
- ii) The Technical Proposal should contain Form-1, Form-2, Form-3, Form-4 and Form -7 duly filled and signed by authorised signatory and authority letter as per Form-5.
- iii) The Bidder should agree to the entire scope of work and deliverables. No proposal for part scope of work will be considered.
- iv) The Bidder should submit a Letter of Authority in favour of the authorised signatory submitting the Bid as per Form -5.
- v) There should be no deviations from any or all the contents of the bidding documents or conditional or alternate bids.
- vi) Adequacy of the proposed Methodology and work Plan in responding to the Scope of Work as per Form - 7.
- vii) Details of past experience are to be provided in Technical Bid as per format provided at Form -2.
- viii) Documentary evidence (e.g. Copy of work Order/Letter of Award/Lol/Purchase Order/proof of payment/in support of past experience. or any other representative documents etc.) to be provided in support of past experience.
- ix) Details of key personnel proposed to be deployed are to be provided in Technical bid as per format provided at Form -4

Bid of any firm not meeting any or all the above criteria, the technical evaluation of the firm will not be carried out and the bid shall be rejected outright.

B. Evaluation of experience of the firm: Maximum 100 Marks

The bidder's relevant experience in the past five years (from Indian FY 2013-14) onwards including the current Financial Year till the date of issue of the tender) will be considered. Experience of the bidders would be evaluated on the following basis:

- i) The Consulting Organization should have assisted the Power Project developer for Super Critical Coal fired Power Project in obtaining Terms of Reference (TOR) and Environmental Clearance (EC) from Ministry of Environment and Forests MoEF during last 5 years i.e. period from Indian FY:2013-14 onwards including the current Financial Year till date of issue of the tender. **Max marks 80** (The marks will be allocated as follows: One assignment = 60 marks, Two assignments = 70 marks, Three assignments or more = 80 marks)
- ii) Adequacy of the proposed methodology and work plan in responding to scope of work and deliverables : **Max marks 20**

PFCCL reserves the right to seek clarifications during the evaluation process of the Technical proposal

The Bidder obtaining 70 marks or more would be regarded as technically qualified Bidder and considered for opening of "Financial Proposal" out of which minimum 10 marks should be obtained in Methodology as at 9.1.1 B ii above.

9.2 Opening of Financial Proposal

The "Financial Proposal" would be opened only of the technically qualified bidders. The date and time of opening of Financial Proposal would be intimated to the technically qualified Bidders separately. The Financial Proposal will be opened in the presence of the authorized representatives of the agencies, who wish to be present.

9.2.1 Financial Proposal Evaluation

Financial Proposals of only such bidders will be opened who have been declared Technically Qualified.

The assignment will be awarded to the technically qualified bidder who has quoted lowest Lump Sum price, in Indian Rupees, without condition(s) or alternate price bid. Conditional Financial Proposals will be rejected outright.

In case of more than one bidder at L1 price, the Assignment will be offered to the bidder quoting L1 price and obtaining the highest marks in the technical evaluation.

10.0 Contract Performance Guarantee (CPG)

In the event of an award, the successful bidder (Consultant), within thirty (30) days of issue of Letter of Award from PFCCL, will be required to arrange submission of CPG in the form of a Bank Guarantee (BG) equivalent to 10% (Ten Percent) of the total consultancy fee. The CPG should be as per PFCCL's proforma and should be kept valid upto 13 (Thirteen) months from the Letter of Award and would be extended upto completion of the Assignment, whichever is later.

11.0 Contract Agreement

In the event of award, the selected bidder (“**Consultant**”) will be required to enter in to a Contract Agreement with the PFCCL within 10 (ten) working days from the date of the Letter of Award (LOA) or within such extended time, as may be granted by the PFCCL.

- 11.1 Formal Contract Agreement will be executed on Non-judicial stamp paper of Rs. 100/- (Rs. one hundred only) as per the format provided by PFCCL. Two sets of Non-Judicial Stamp papers of Rs.100/- each and water mark papers to be purchased by the Consultant from Delhi State.
- 11.2 The Agreement will be signed in two originals and the consultant shall be provided with one signed original Agreement
- 11.3 The date of execution of the contract agreement in no case shall alter the date of start or completion period of the work.
- 11.4 Till the time a ‘Contract Agreement’ is prepared and executed, the Letter of Award shall be read in conjunction with the Bidding Documents and will constitute a binding contract.

12.0 Validity of Bid

Bidders shall keep their bids /proposals valid up to 120 (One hundred Twenty) days from the date of opening of the Financial Proposals. Bidders may be required to further extend the validity of Bid as per the requirement of PFCCL.

13.0 Terms of Payment

Payments would be made as per the following Stages:

Sl. No.	Description	Payments as % of Lump Sum Contract Price
i.	Advance for Site Mobilization against submission of Bank Guarantee (BG) of equivalent amount as per PFCCL proforma to be valid for 6 months from the date of Letter of Award. (To be recovered in two equal installments from the stage payments i.e. from 13 ii) and 13 iii). In case no such stage payment becomes due till the expiry of Bank guarantee, the same will be required to be extended for a further period of 6 months on one occasion till such period the amount is completely recovered)	10%
ii.	Obtaining “TOR” from MoEF&CC, as may be applicable along with Site Feasibility Study Report.	10%
iii.	Submission of Rapid EIA Report, Socio economic Report, Social Impact Assessment, R&R and CSR Report etc.	25%
iv.	Submission and acceptance of Detailed Project Report/ Project Information Report and completion of activities required for filing application to SPCB/MoEF, as may be applicable for Environment Clearance and upon filing application	40%
v.	Upon receipt of Environmental Clearance from SPCB/MoEF, as may be applicable.	25%

The price offer for the Assignment should be quoted on lump sum basis inclusive of all taxes and duties etc as may be applicable. No escalation for any reason whatsoever shall be allowed over and above the bid price. However, GST, if any, at applicable rates, on the date(s) of payment(s) shall be paid over and above the bid price.

The Consultant shall submit the bills in duplicate to PFCCL addressed to CEO, PFCCL, indicating the stage achieved, out of the ones indicated above.

14.0 Travel Expenses

All related travel expenses incurred by the Consultant's personnel for journeys to site or Client's Office or anywhere in connection with the consultancy services/study under Scope of this Specification will be borne by the Consultant and the Client will not take any responsibility whatsoever on this account

15.0 Other Terms & Conditions

- i) The financial proposal by the bidders shall be in Indian Rupees as per format enclosed (Form 6) with no escalation provision for any reason whatsoever till the completion of the Assignment.
- ii) The Consultant shall make available the services of the identified personnel as may be required for successful execution of the assignment and or as may be required by PFCCL on specified dates, venues and time in order to meet the obligations of PFCCL.
- iii) All claims shall be raised by the Consultant as per the terms of payment after being due, and would be accepted for payment based on satisfactory progress and quality of the work at the sole discretion of the competent authority.
- iv) In case the performance of the proposed team member(s) is not satisfactory, the Consultant will be asked to change/replace the team member(s) within three days of receipt of such request from PFCCL with a member acceptable to PFCCL.
- v) PFCCL with the approval of CEO, can cancel the contract at any stage of the work, in case it is found that the knowledge of a team/team member(s) and or his/her performance is not satisfactory, any information given at the time of submission of the bid is found to be incorrect.
- vi) Given the nature of the work being entrusted, the firm would have to give an undertaking to the effect that the contents/ essence of any reference/ documents given would not be disclosed to any third person without the express approval of PFCCL, failing which the engagement of the firm could be terminated.
- vii) If due to any reason or decision of the Govt/Client. the Assignment is dropped and the Consultant is directed to discontinue work, the "Drop Dead Fee" would be limited to the payments received by the Consultant and the claims already raised, as per the payment terms relating to the Assignment, till the point of calling off the Assignment or as mutually agreed.
- viii) **Conflict of Interest:** Organisations would not be hired for any work whose interests are in conflict with their prior or current obligations to the other

organisations/ clients or that may place them in a position of being unable to carry-out the work assigned to them at any point of time during the currency of engagement by PFCCL or above all enable them to pose a threat to PFCCL's consulting business in future. Without limitation on the generality of the foregoing, organisations would not be hired, under the circumstances set forth below:

Organisations who have business or family relationship with member(s) of PFC's and/or PFCCL's employees or persons positioned in or on the Board of these two organisations by whatever process, would not be engaged. A declaration to this effect would be taken from the organisation when being engaged, and if found incorrect, the organisation would be debarred from any further engagement by PFCCL ever.

- ix) The Consultant shall keep PFCCL, both during and after the term of this Contract, fully and effectively indemnified against all losses, damage, injuries, deaths, expenses, actions, proceedings, demands, costs and claims, including, but not limited to, legal fees and expenses, suffered by PFCCL or any Third Party, where such loss, damage, injury or death is the result of a wrongful action, negligence or breach of contract by the Consultant, or the Consultant's personnel, including the use or violation of any copyright work or literary property or patented invention, article or appliance
- x) No offer should be sent by Fax or E-mail.
- xi) Offers received in the designated office after the due time and date mentioned above shall not be considered.
- xii) PFCCL reserve the right to accept or reject any or all Proposals/Offer or annul the bid Process or modify/ change the content of the bid document without assigning any reason.
- xiii) PFCCL shall not entertain any claim of any nature, whatsoever, including without limitations, any claim of expenses in relation to the preparation, submission or any other activity relating to bidding or any other expense till award of contract.

Yours sincerely,

FOR and on behalf of PFC CONSULTING LTD

**(Yogesh Juneja)
Executive Director**

Encl.: As Above

SECTION -2

BID FORMS AND PROFORMA

FORM – 1: COVERING LETTER

From: _____ To: Executive Director
Name: _____ PFC Consulting Ltd.,
Designation: _____ First Floor, Urjanidhi,
Address: _____ 1, Barakhamba Lane,
Connaught Place,
New Delhi – 110 001

Sir,

Sub: Assistance to PFC Consulting Limited (PFCCL) for Consultancy Services for Site Feasibility Study, Conducting various Technical Studies & obtaining Environment Clearance for 2x660 MW Thermal Power Project to be set up by Sangam Power Generation Company Limited in the State of Uttar Pradesh.

We _____ (Name of consulting organization) herewith enclose Technical & Financial proposal for selection of our organisation as consultant on lump sum basis for assisting PFCCL on Consultancy Services for **Site Feasibility Study, Conducting various Technical Studies & obtaining Environment Clearance for 2x660 MW Thermal Power Project to be set up by Sangam Power Generation Company Limited in the State of Uttar Pradesh.**

1. We are submitting our bid consisting of:
 - i) **Technical Bid** in a sealed envelope consisting of:
 - a) Details of Technical Qualification (Past experience) of the firm as per format provided at Form -2 of Section-2 of Bid Document.
 - b) Documentary evidence in support of past experience.
 - c) The proposed methodology and work plan in responding to the Scope of Work as per format provided at Form-7 of Section-2 of Bid Document.
 - d) Detailed CVs of the key Personnel proposed to be deployed for the assignment as per format provided at Form-4 of Section-2 of Bid Document.
 - ii) **Price Offer** (as per format provided at Form 6 of Section 2 Bid document) in a sealed envelope
2. _____ [Name and contact information of one of the team member] shall be the Team Leader for the assignment.
3. We declare that the above quoted lump sum fee is firm and shall remain valid for the entire period of the consultancy assignment. We further declare that the above quoted fee includes all taxes (excluding GST) payable by us under this consultancy assignment.
4. We hereby confirm that if any Income Tax, Surcharge or any other Corporate Tax is attracted under the law, we agree to pay the same to the concerned authorities.

5. We confirm that the prices and other terms and conditions of this proposal are valid for a period of 120 days from the date of opening of the Financial Proposal.
6. We declare that the services will be rendered strictly in accordance with the specifications. We confirm our acceptance/compliance to the `Deliverables` and `Terms of payment` clauses as stipulated in the bid documents. We confirm that Contract performance Guarantee for ten (10) % of the total consultancy fee in the form of bank guarantee shall be provided by us as per the prescribed format (*to be provided to successful bidder*) in case of placement of award.
7. We hereby declare that only the company, persons or firms interested in this proposal as principal or principals are named herein and that no other company, person or firm other than one mentioned herein have any interest in this proposal or in the contract to be entered into, if we are awarded this contract.
8. We declare that the services will be rendered strictly in accordance with the specifications and we do not have any deviation to any of the terms and conditions of the bidding documents.
9. We confirm and certify that all the information / details provided in our bid are true and correct.
10. We give our unconditional acceptance to the Bid Documents issued by PFCCL, as amended. We shall execute the Contract Agreement as per the provisions of the Bid Document.
11. Further, we confirm that we agree and seek no deviations from the scope of work, time schedule, deliverables, payment terms and all other terms and conditions as contained in the `Bid Document`. The proposal is unconditional. The Bid will be valid 120 (One hundred twenty days) from the opening of financial bid.
12. We also declare that by taking this assignment we do not have any conflict of Interest with any of our prior or current obligations to other organisations/clients and also do not have business or family relationship with member(s) of PFC's and/or PFCCL's employees or persons positioned in or on the Board of these two organisation by whatever process and if found incorrect, we may be debarred from any further engagements by PFCCL forever.
13. We certify that all the information provided in our bid, including the information regarding the team members, are true. We understand that any willful misstatement in the bid may lead to disqualification or cancellation of award if made or termination of contract. We also understand that in such a case we may be debarred for future assignments with PFCCL for a period of maximum three years from the date of such disqualification.

14. Further, we undertake that in the event of our appointment as sub consultant, given the nature of the work being entrusted, the contents/ essence of any reference/ documents given would not be disclosed to any third person without the express approval of PFCCL, failing which the engagement of the organisation would be terminated.

Signature of Authorized Person

Name

Designation & Company seal

Date:
Place:

FORM – 2: EXPERIENCE OF ORGANISATION

1. Brief Description of the Organisation:
2. Outline of experience on assignments:

Sl. No.	Name of Assignment with work order no. and date	Name(s) of member(s) associated with the assignment	Client	Date of Commencement	Date of Completion	Scope in brief
1						
2						
3						

1. It is hereby certified that the above mentioned details are true and correct.
2. It is hereby certified that our company has actually carried out and completed the above mentioned work/assignments

Signature of Authorized Signatory

Full Name

Address

Note:

1. Experience on assignments of the firm from FY 2013-14 onwards including the current Financial Year till the date of issue of the tender for obtaining Environment Clearance including carrying out Site Feasibility Study, Conducting various Technical Studies, Preparation of Rapid Environmental Impact Assessment (EIA) Report. Preparation Project Information Report etc. for **at least one Unit of 660 MW for a Thermal Power Project** is required to be submitted relevant to the present assignment.
2. Please attach documentary proof for claimed experience, the proofs could be namely, copy of Letter of Award and / or any other documentary evidence for proof of completion or proof of payments received against such services etc.

FORM – 3: COMPOSITION OF TEAM AND THE TEAM LEADER TO BE DEPLOYED

	Name
	<u>Team Members</u>
	Team Leader
1	
	Other Members
2	
3	
4	
5	
6	

Signature of Authorized Signatory

Full Name

Address

FORM – 4: CURRICULUM VITAE FOR EACH MEMBER OF CONSULTANT’S TEAM

Name: _____

Profession/ Present Designation: _____

Total post qualification experience: _____ Years with organisation: _____

Educational Qualification: _____

(Under this heading, summarise college/ university and other specialized education of staff member, giving names of colleges, etc. degrees obtained.)

(Please enclose attested copy of educational qualifications)

Experience:

(Under this heading, list of positions held by staff member since graduation, giving dates, names of employing organisation, title of positions held and location of assignments.)

Language:

(Indicate proficiency in speaking, reading and writing of each language by ‘excellent’, ‘good’ or ‘poor’)

Certification:

I, the undersigned, certify that to the best of my knowledge and belief, this CV correctly describes me, my qualifications, and my experience. I understand that any wilful misstatement described herein may lead to disqualification of the firm.

Signature of Team member

Full Name

Date

Signature of Authorised Signatory

Full Name

Date

FORM – 5: AUTHORISATION LETTER
(ON THE LETTER HEAD OF THE ORGNISATION/FIRM)

I _____ certify that I am _____ of the Organisation, organised under the laws of _____ and that _____ who signed the above Proposal is authorised to bind the organisation by authority of its governing body.

Signature:

Full Name:

Address:

(Seal)

FORM – 6: SCHEDULE OF PRICE BID

(To be submitted as Financial Proposal in Third Envelope)

Sub: Assistance to PFC Consulting Limited (PFCCL) for providing Consultancy Services for Site Feasibility Study, Conducting various Technical Studies & obtaining Environment Clearance for 2x660 MW Thermal Power Project to be set up by Sangam Power Generation Company Limited in the State of Uttar Pradesh

I _____ (Name) on behalf of _____ (Name of the Consultancy Organisation) herewith submit the Financial Proposal for providing **Consultancy Services for Site Feasibility Study, Conducting various Technical Studies & obtaining Environment Clearance for 2x660 MW Thermal Power Project to be set up by Sangam Power Generation Company Limited in the State of Uttar Pradesh**

Sl. No.	Activity	Lump Sum Price in INR in Figures	Lump Sum Price in INR in Words
1.	Geo-technical Investigation		
2.	Area Drainage and Hydrology Study		
3.	Water availability study including design drawing of pipelines and intake points/wells etc. including optimization of Cycles of Concentration (COC), water balance diagram etc.		
4.	General & Topographical Survey of the study area, Preparation of PFR for obtaining Terms of Reference (ToR); Land Use Plan; Preparation of layout plan; Corridors Route survey for water and ash pipeline, EIA Studies like REIA, Cumulative EIA etc. as may be prescribed in ToR for Environment Clearance and other Statutory Clearances such as State Pollution Board Clearance etc including organizing Public Hearing, Submission of Application for other statutory clearances including and obtaining EC and any other activities.		
5.	Socio-economic study, SIA Report, preparation of R&R Plan, CSR Plan, including land requirement, layout, drawing and design of R&R infrastructure and R&R package as per the policy of State Govt.		
6.	Preparation of Detailed Project Report/ Project Information Report for obtaining EC		
7.	Total		

Note:

1. The price offer for the Assignment should be quoted on lump sum basis. No escalation for any reason whatsoever shall be allowed over and above the bid price till completion of the assignment. However, GST, at applicable rates, on the date(s) of payment(s) shall be paid over and above the bid price.
2. Income tax at source will be deducted by PFCCL as per the applicable law and regulation and TDS certificate shall be issued to the consultant by PFCCL
3. In case of more than one bidder at L1 price, the Assignment will be offered to the bidder quoting L1 price and obtaining the highest marks in the technical evaluation.
4. The financial proposal with condition(s) or alternate price bid will be summarily rejected.
5. ***PFCCL reserves the right to exclude any of the above activity(ies) mentioned above and as such the Consultancy Fee for the assignment would be reduced accordingly.***

Address

Authorised Signatory

Seal

Full Name

FORM -7 : THE PROPOSED METHODOLOGY AND WORK PLAN

Bidder`s Name & Address

To

PFC Consulting Limited
(A wholly owned subsidiary of Power Finance Corporation Ltd.)
First Floor, "Urjanidhi", 1-Barakhamba Lane
Connaught Place
New Delhi-110 001

Dear Sir,

We hereby enclose a brief write up on the proposed methodology to be adopted for **Consultancy Services for Site Feasibility Study, Conducting various Technical Studies & obtaining Environment Clearance for 2x660 MW Thermal Power Project to be set up by Sangam Power Generation Company Limited in the State of Uttar Pradesh** indicating the following.

- i) Approach Methodology and Work Plan in responding to scope of work and deliverables
- ii) Key Personal and their Task Assignment for Completing the Assignment

Authorised Signatory:

Full Name:

Address:

(Seal)

PROFORMA FOR BANK GUARANTEE FOR CONTRACT PERFORMANCE
(TO BE STAMPED IN ACCORDANCE WITH STAMP ACT)

The non-judicial stamp paper should be in the name of issuing bank

Ref. No. Bank Guarantee No.....Date.....

To,

Employer Name and Address

Dear Sirs,

In consideration of the PFC Consulting Limited (hereinafter referred to as the `Owner` which expression shall unless repugnant to the context or meaning there of include its successors, administrators and assigns) have awarded to M/swith its Registered/Head Office at (hereinafter referred to as the `Consultant by issue of Owner's Letter of Award Nodated

and the same having been unequivocally accepted by the Contractor/Consultant resulting into a contract valued atfor(Scope of Contract) and the Contractor/Consultant having agreed to provide a Contract Performance Guarantee for the faithfully performance of the entire contract equivalent to% (per cent) of the said value of the contract to the Owner.

We(name and address), having its Head Office at(herein after referred to as the `Bank`, which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) do hereby guarantee and undertake to pay the Owner, on demand any and all monies payable by the Contractor/Consultant to the extent ofas aforesaid at any time upto.....

(days / month/year) without any demur, reservation, contest, recourse or protest and/or without any reference to the Contractor/Consultant any such demand made by the Owner on the Bank shall be conclusive and binding notwithstanding any difference between the Owner and Contractor/Consultant or any dispute pending before any court, tribunal or any other authority. The Bank undertakes not to revoke this guarantee during its currency without previous consent of the Owner and further agrees that the guarantee herein contained shall continue to be enforceable till the Owner discharges this guarantee. The Owner shall have the fullest liberty without affecting in any way the liability of the Bank under this guarantee from time to time to extend the time for performance of the contract by the Contractor/Consultant. The Owner shall have the fullest liberty, without affecting this guarantee, to postpone from time to time the exercise of any powers vested in them or of any right which they might have against the contractor/consultant, and to exercise the same at any time in any manner, and either to enforce or to forbear to enforce any covenants, contained or implied, in the Contract between the Owner and the Contractor/Consultant or any other course of or remedy or security available to the Owner. The Bank shall not be released of its obligations under these presents by any exercise by the Owner of its liberty with reference to the matters aforesaid or any of them or by reason of any other acts of omission or commission on the part of the Owner or any other indulgence shown by the Owner or by any other matters or thing whatsoever which under law would, but for this provision, have the effect of relieving the Bank.

The Bank also agrees that the Owner at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor/Consultant and notwithstanding any security or other guarantee that the Owner may have in relation to the Contractor/ Consultant liabilities.

Notwithstanding anything contained herein above our liability under this guarantee is restricted toand it shall remain in force upto and includingand shall be extended from time to time for such period (not exceeding one year), as may be desired by M/swhose behalf this guarantee has been given.

Dated this Day of 2018.....at

WITNESS: (Authorised Signatories of the Bank)

1.

.....
(Signature)

.....
(Signature)

.....
(Name)

.....
(Name)

.....
(Official address)

.....
(Designation with Bank Stamp)

Attorney as per Power of Attorney No.

Dated

2.

.....
(Signature)

.....
(Name)

.....
(Official address)

Note: This sum shall be ten percent (10% of the total Contract Price).

The stamp paper of appropriate value shall in the name of Bank issuing the guarantee.

PRO FORMA OF BANK GUARANTEE FOR ADVANCE PAYMENT
(TO BE STAMPED IN ACCORDANCE WITH STAMP ACT)

The non-judicial stamp paper should be in the name of issuing bank

Ref: _____

Bank Guarantee: _____

Date: _____

Dear Sir,

In consideration of M/s _____ (Hereinafter referred as the 'Owner', which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, and assigns), having awarded to M/s. _____ (hereinafter referred to as the 'Technical Consultant' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns), a Contract by issue of Owner's Letter of Award/ Contract Agreement No. _____ dated _____ and the same having been unequivocally accepted by the Consultant. resulting in a Contract valued at _____ for _____ (Scope of Work)

Contract (hereinafter called the 'Contract') and the Owner having agreed to make an advance payment to the Consultant for performance of the above Contract amounting to _____ (in words and figures) as an advance against Bank Guarantee to be furnished by the Consultant.

We _____ (Name of the Bank) having its Head Office at _____ (hereinafter referred to as the Bank), which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators executors and assigns) do hereby guarantee and undertake to pay the Owner immediately on demand any or, all monies payable by the Consultant to the extent of _____ as aforesaid at any time upto @ _____ without any demur, reservation, contest, recourse or protest and/or without any reference to the Consultant. Any such demand made by the Owner on the Bank shall be conclusive and binding notwithstanding any difference between the Owner and the Consultant or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. We agree that the guarantee herein contained shall be irrevocable and shall continue to be enforceable till the Owner discharges this guarantee.

The Owner shall have the fullest liberty without affecting in any way the liability of the Bank under this Guarantee, from time to time to vary the advance or the extend the time for performance of the Contract by the Consultant. The Owner shall have the fullest liberty without affecting this guarantee, to postpone from time to time the exercise of any powers vested in them or of any right which they might have against the Owner and to exercise the same at any time in any manner, and either to enforce or to forbear to enforce any convenience, contained or implied, in the Contract between the Owner and the Consultant any other course or remedy or security available to the Owner. The Bank shall not be relieved of its obligations under these present by any exercise by the Owner of its liberty with reference to the matters aforesaid or any of them or by reason of any other act or forbearance or other acts of omission or commission on the part of \the Owner or any other indulgence shown by the Owner or by any other matter or thing whatsoever which under law would but for this provision have the effect of relieving the Bank.

The Bank also agrees that the Owner at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Consultant and notwithstanding any security or other guarantee that the Owner may have in relation to the Consultant's liabilities.

Notwithstanding anything contained herein above our liability under this guarantee is limited to _____ and it shall remain in force upto and including @ _____ and shall be extend from time to time for such period (not exceeding one year), as may be desired by M/s. _____ on whose behalf this guarantee has been given.

Date this _____ day of _____ 2018 _____
at _____

WITNESS

(Signature)

(Signature)

(Name)

(Name)

(Official Address)

Designation (With Bank Stamp)

Attorney/signature No. _____

Dated _____

Strike out, whichever is not applicable

@ The date will be 6 (six) months from the date of Letter of Award.

Note:1 The stamp papers of appropriate value shall be purchased in the name of bank who issues the 'Bank Guarantee'.

SECTION -3

TECHNICAL SPECIFICATIONS

(These Specifications are standard and indicative only, however, the bidders are required to adopt the best industry practice/international norms for carrying out the Scope of Work and Deliverables.)

SECTION -3

TECHNICAL SPECIFICATIONS

Table of Contents

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CHAPTER -01

PROJECT INFORMATION REPORT

1.0 The Project Information Report should prepared as per MoEF Guidelines and shall include the following;

S. No.	Description	Remarks
1.0	Brief Background	
2.0	Environmental aspects Detailed write up on environmental aspect may be given covering the following. i) Emission level ii) Effluent treatment iii) Ash management/ utilization. iv) Environment monitoring. v) Rehabilitation & Resettlement. vi) Environment Impact Assessment. vii) Sitting criteria of MoEF and its compliance. viii)	
2.1	Details of Ecologically Sensitive Areas like tropical forests, biosphere reserves, national park, sanctuaries, important lakes, endangered species of flora & fauna and distance from site etc.	
3.0	Details of the following within 10 Kms radius of the proposed location(s)	
3.1	Places of Archaeological importance, river, streams, Estuary, sea, hills/mountains etc.	
3.2	Places of Historical, Cultural, Religious or Tourist importance	
3.3	Defence installation	
4.0	Location Details	
4.1	State/District/Village	
4.2	Longitude & Latitude	
4.3	Nearest town & distance, nearby industries (cement, power etc)	
5.0	Approach to Site	
5.1	Rail	
i)	Nearest Rail Head & Distance	
ii)	Type (BG/MG) Length of the railway siding required	
5.2	Road	
i)	Existing Highway/roads distance from site	
5.3	Distance from nearest airport (existing/proposed)	
5.4	Distance from big cities.	

5.5	Distance from nearest waterways	
5.6	Constraints if any to approach site particularly for construction materials, plants and equipments etc. and indicate requirement of bridges etc.	
6.0	Land Availability	
6.1	Extent of land available for Plant, Township, Ash Disposal etc.	
6.2	Land use pattern (agricultural, barren, forest etc.	
6.3	Incase of agricultural land, whether irrigated/non irrigated, number of crops	
6.4	Land ownership (Govt. Pvt., tribal, non-tribal etc.)	
6.5	Prevailing land cost details	
6.6	Estimation of population affected, Homestead Oustees, Land Ownership Details	
7.0	Topography of the area	Topography survey as per specification enclosed.
7.1	Ground profile and levels	
7.2	Permanent features	
8.0	Soil Condition	Soil investigation as per specification enclosed.
9.0	Site Data	
9.1	Whether the site is flood prone & HFL of the site	
9.2	Existence of mines and present & future development activity/proposal	
9.3	Drainage study	as per specification enclosed.
10.0	Water	
10.1	Source of Circulating/Consumptive water	
10.2	Location in relation to River/Canal/Dam, water availability and quality	
10.3	Lean season water availability and allocation source in case main source not perennial.	
10.4	Approved water allocation quota (Drinking, Irrigation and Industrial use) and surplus availability	
10.5	Inter-State Issue, if any	
10.6	Requirement of construction of Dam/barrage storage etc. if any and its location.	
10.7	Feasible ways of bringing water to site indicating constraints if any.	

10.8	Recommended type of cooling system	
11.0	Fuel - Coal	Details of captive blocks/linkage shall be provided by PFCCL.
11.1	Source of Coal & distance	
11.2	Availability(probable mines, parameters, production programme, cost details)	
11.3	Transportation arrangement contemplated	
12	Fuel Transportation	
12.1	The feasibility of availability of corridor for the MGR system for pithead sites, approximate lengths equipment & cost details.	
12.2	If transportation contemplated through railway network then surplus carrying capacity available, future expansion proposal including programme.	
12.3	New facilities needed	
i)	At mine(s)	
ii)	At power station	
iii)	At Railways.	
13.0	Ash Disposal/Utilization	
13.1	Proposed ash disposal arrangement	
13.2	Details of existing & proposed cement plants and quantity of ash, which could be utilized in such cement plants.	
13.3	Various other feasible ways to utilize ash.	
13.4	Plan for 100% ash utilization	
13.5	Requirement of land for ash pond.	
14.0	General	
14.1	Source of construction water and potable water	
14.2	Source of construction power & start up power	
14.3	Source of availability of construction material like sand, brick, stone chips, borrow earth etc.	
15.0	Proximity to infrastructure facilities available nearby	
15.1	Hospital	
15.2	Schools	
15.3	Residential accommodation	
16.0	Location & vicinity plan identifying the areas proposed for power plant, colony & ash disposal	
17.0	Techno-Economic Feasibility from considerations of,	
17.1	Land availability & its development	
17.2	General Layout	
17.3	Rehabilitation & Resettlement issue	
17.4	Access to site for Transportation of equipments/construction machinery, material etc.	
17.5	Water availability for cooling & consumptive use.	
17.6	Fuel availability and its transportation	
17.7	Environmental and forest aspects.	

17.8	Power evacuation.	
18.0	Ultimate plant capacity, which could be set up.	
19.0	Conclusions and Recommendations.	
20.0	Complete technical profile of the project giving technical parameters of the plant & equipment. (proposed plant capacity is 660*2 mw with super critical technology)	
21.0	Meteorological data like temp., humidity, rainfall, wind pressure & wind direction.	
22.0	Seismological studies of project specific design seismic parameters.	
23.0	Hydrological studies for flood aspects and protection measures if necessary.	
24.0	Project implementation:-Schedule showing various activities.	
25.0	Power evacuation and associated transmission system.	The consultant to interact with PGCIL/State Utilities & Power system group of CEA to prepare the power evacuation plan.
26.0	Power demand & supply position on regional basis.	Data

CHAPTER-02
AREA DRAINAGE STUDY

1.0 Scope of Studies:

Following studies would be undertaken:

- i) Study of available information in the form of reports, literature, satellite images etc having a bearing on the area drainage plan. The study shall include review of topographical features of the proposed site for the Power Project and its surrounding area.
- ii) Digitizing topographical information for the study area. It includes contours and spot elevations, drainage network, village boundaries, roads and railways.
- iii) Review and analysis of rainfall information to arrive at design storm scenarios of various return periods including Standard Project Storm/Probable Maximum Precipitation as may be applicable.
- iv) Preparation of digital elevation model for the study area for delineation of catchments and delineation of drainage network for comparison with drains of topo sheet. Registration of satellite image.
- v) Compilation of land use, soil and other characteristics of the catchments for determining rainfall excess using an appropriate method.
- vi) Application of event based model for the estimation of flood hydrographs considering historical as well as design rainfall for different return periods.
- vii) Estimation and routing of flood hydrograph, by hydraulic modeling for routing the flood waters calculated from the hydrologic study using one dimensional mathematical model, through the drainage system of concerned catchments considering appropriate boundary conditions including pre-project scenario as well as post-project scenario.
- viii) Site visit for reconnaissance survey and on the spot collection of data necessary for satisfactory completion of the area drainage study.
- ix) Visit to PFFCL/Client Office for discussions regarding the studies.
- x) To suggest rerouting/remodeling of existing drains or Nallahs if they become inoperative due to filling or leveling of land.
- xi) To suggest suitable quantity and source of filling material. (in case any filling is required to maintain safe elevation of the main power plant & auxiliary equipments)

CHAPTER-03

TOPOGRAPHICAL SURVEY

1.0 SCOPE OF WORK

- 1.1 The Consultant/Contractor shall carry out the preliminary survey of the selected site. The selected site may have about **1300Acres** of land. Detail studies as per scope of work shall be carried out in the selected land after completion of preliminary survey.
- 1.2 Carrying out the Bench Mark (GTS/any other reference Bench Mark approved by PFCCL/Client) to site/sites under survey by parallel leveling, establishing and constructing bench mark, grid and reference pillars in the field, spot level survey of the entire area/areas at specified intervals and development of the contours.
- 1.3 Carrying out cross-section of river/canal taking spot levels at 5 meter interval or less depending up Providing necessary surveying instruments and all other tools and materials, labour and qualified surveyors, scaffoldings, necessary transport, supervision by competent engineers/ surveyors, full insurance and all other incidental items as may be necessary for successful completion of the surveying and mapping work.
- 1.5 Furnishing all field data & drawings in soft copy (on CDs) apart from hard copies.
- 1.6 Furnishing of the survey report as described in details in the succeeding paragraphs is also included in the scope of this work.

2.0 CARRYING OUT AND SETTING UP OF BENCH MARK & REFERENCE PILLARS

- 2.1 The Contractor shall carry out Bench Mark by fly-leveling from nearest GTS Bench Mark or available source as approved by the PFCCL and establishes the same on a permanent Bench Mark to be constructed as per the sketch (to be provided at later stage) at a convenient location at site. All subsequent transfer of levels shall be carried out with respect to this Bench Mark. **This will be the responsibility of the successful bidder to obtain standard benchmarks from the department of Survey of India, Dehradun.**
- 2.2 The work shall also include constructing permanent reference pillars as per the sketch (to be provided at later stage) at suitable locations as approved by the PFCCL. These reference pillars shall be labeled permanently with their respective coordinates and reduced levels for future use. The Bench Mark and reference pillars shall be shown on the survey drawings.
- 2.3 The fly leveling should be carried out using two good quality levels simultaneously. The leveling instruments should always be kept free of collimation error that should be checked and adjusted before start of work every day. A record of adjustments should be kept in the field book.
- 2.4 While carrying bench mark to the project site, levels shall be established on the permanent objects like culverts etc. at least on one object in every one km. if available along with route with adequate description about the objects and levels shall be maintained & mentioned in the survey report to facilitate locating these objects later on.

The route for transferring the levels shall follow the existing roads wherever available and this route shall require the approval of the PFCCL.

- 2.5 Carrying out of the Bench Mark shall not be paid separately. Rates for this should be in built in the rates for topographical survey work.
- 2.6 Closing error in leveling should be limited to $12 \sqrt{L}$ mm, where L is the length of the route in kms.

3.0 TOPOGRAPHICAL SURVEY AND MAPPING

- 3.1 Positions, both in plan and elevation, of all natural and artificial features of the area like waterways, railway tracks, trees, cultivation, houses, fences, pucca and kutcha roads including culverts and crossings, foot tracks, other permanent objects like telephone posts and transmission towers etc. are to be established and subsequently shown on survey maps by means of conventional symbols (preferably, symbols of survey of India Maps), all hills and valleys within the area/areas are to be surveyed and plotted on maps by contours. Necessary leveling work of the entire area/areas are to be surveyed and plotted on maps by establishing horizontal location so that location and sketching of contours for the area/areas can be done at specified intervals and in specified scales on maps. Method of survey, contour intervals etc. shall be decided by engineer-in-charge on site in case of steep slopes and dense jungle etc. where gridding is not possible. Any unusual condition or formations on the ground, locations of rock outcrops (if visible on the surface) and spring/falls, possible aggregate deposits etc. shall also be noted and plotted on the maps.

The fieldwork shall be done with Total Station Equipment in the following steps:

- i) Establishing horizontal and vertical controls and locating reference grids and bench mark in the area.
- ii) Surveying for establishing spot levels and plotting contours.
- iii) Surveying for locating the natural and manmade details as described earlier.

The grids for the survey work shall be established in N-S & E-W direction (Corresponding to magnetic North) or the Plant North as directed by the PFCCL.

4.0 TRAVERSING

- 4.1 Triangulation or traversing or a combination of the two methods shall be adopted for the purpose of establishing horizontal control and in order to determine the exact relationship between various existing points on ground so that surveys required under the present scope of work and in future may be co-related and tied together.
- 4.2 Total intelligent station instruments should be deployed to achieve the specified accuracy of the work. Proper precautions for avoiding graduation errors and other instrumental and personal errors should be scrupulously observed.
- 4.3 From main traverse/triangulation station, subsidiary station shall be established at suitable intervals to cover the entire area. Levels of these station shall be based on the Bench Mark established in the survey area. Occupying the main & subsidiary stations, all major details shall be surveyed by Total Station instrument. Further classification of details if necessary shall be carried out with plain table method.

4.4 The closing error in traverse shall not exceed one in twenty five thousand (1:25000) in terms of length or $L\sqrt{N}$ seconds total in angular measurement, whichever is less (where L is the least count of the instrument and N is the number of stations).

5.0 CONTOURING

5.1 Contractor shall carry out spot level surveying at an interval of 25 meters for contouring the area. Levels shall also be taken on all traverse stations and on salient points located at random over the area (ground points). Contours are to be interpolated at 0.5 M intervals after the above points are plotted. The contours shall not be just interpolated but properly surveyed on the ground so that features falling between the two successive levels are also picked up. Sufficient points properly distributed over the entire area shall be located and levels taken so that accurate contouring can be done at places of sharp curvature or abrupt change in direction and elevation, points selected shall be close to each other. Salient points on ridgelines and valley lines shall also be measured.

5.2 Transfer of levels shall always start from Main/Subsidiary stations whose levels are based on benchmark established in the survey area.

6.0 LATITUDE AND LONGITUDE

The contractor shall tie up the survey grids of areas surveyed with latitudes and longitudes.

7.0 CONSTRUCTION OF BENCH MARK, REFERENCE & GRID PILLARS:

7.1 Bench Marks shall be constructed underground as per the sketch for each isolated area. The reduced level of the top of the bolt shall be engraved clearly on the top of the concrete pillar. The top surface of the bolt shall be painted with anticorrosive paint. The back filling of the pillar shall be done after engraving the BM value & reference coordinates with respect to survey grid on the concrete of the BM pillar and reference pillars.

7.2 There shall be one reference pillar constructed within one meter of each Bench Mark pillar. The relation of these pillars w.r.t. the BM pillar and survey grids should be established and indicated in the drawings. The co-ordinates should be transferred & punched on the top of the steel plate of reference pillars.

7.3 Concrete pillars shall be constructed at the (intersection of the 200 M grid lines which should be established at in N-S and E-W direction corresponding to magnetic North) or Plant North or as directed by Client/PFCCL and their coordinates with reference to the survey grids shall be engraved on the top of the pillars. The pillars should be white washed.

7.4 Additional 4 to 6 reference pillars shall have to be constructed by the contractor in addition to those covered under Cl.10.2.0 at no extra cost to the owner. Location of these shall be decided by Client/PFCCL.

8.0 PREPARATION & SUBMISSION OF SURVEY MAPS

8.1 The Contractor shall submit survey maps of the site in 1:1000 scale (or as directed by PFCCL) indicating grid lines and contour lines, demarcating all permanent features like roads, railways, waterways, buildings, power lines, natural streams, trees etc. Each area

should have two originals one showing spot levels and contours with grid lines and other with grid lines, contour lines and permanent features.

- 8.2 One set of maps for the entire area should also be submitted in 1:4000 scale (or as directed by PFCCL) as indicated in para 8.1 above.
- 8.3 One map in 1:4000 scale (or as directed by PFCCL) indicating land classifications as mentioned in para 9.5 should also be submitted.
- 8.4 One composite map in 1:10000 scale (or as directed by PFCCL) indicating all features as per para 8.1 and contour at an interval of 5.00m.
- 8.5 The Mauza and Khasra map of the area should be collected by the Contractor from the local revenue authorities and survey grids to be superimposed on the maps. The scale of this map should be same as that for the Mauza/Khasra map or as directed by PFCCL.
- 8.6 All the maps should be prepared in digitized forms using Inkjet/Pen plotter and standard computer software like AutoCAD–12/13 or auto civil on standard A-0 size polyester base film. The block of name plate of all the drawings should be as per PFCCL standard.
- 8.7 The Contractor shall submit two copies of all the maps for review and approval of the Engineer-in-Charge. After approval, 5 (five) prints of all the final maps along with a set of the originals on polyester base film shall be submitted. Copies of the maps shall be submitted in proper flappers and original polyester base drawings should be handed over in proper cardboard covers indicating index of drawings.

9.0 SUBMISSION OF FIELD DATA AND REPORT

- 9.1 Contractor shall submit all data pertaining to the survey in original to the PFCCL office.
- 9.2 All field data shall be submitted to PFCCL from time to time as per progress of the work.
- 9.3 Two copies of the draft report shall be submitted on the completion of the field work for review and approval of the PFCCL. The report should give the introduction of the site, methodology adopted for surveying the areas, calculation of errors, transfer of Bench Mark, calculation for connecting the areas with latitudes and longitudes and any other calculation required for surveying and preparation of the survey maps.
- 9.4 The agricultural survey (Land Use Pattern) and population survey (village wise population) of the area surveyed shall form the part of the Survey Report.
- 9.5 The agricultural survey shall give details about the various types of land e.g. cultivated, private land, Abadi land, Govt. reclassified land, forest land, Gram Samaj land etc. falling within the area surveyed including its ownership types and number of crops grown throughout the year, system of irrigation adopted and the prevalent cost of each type of land, duly authenticated by the competent authority of the state or from local enquiries.
- 9.6 The population survey shall also include the number of huts, pucca houses, tube wells, lined wells, number of families and family members (Male, Female and minor children) coming within the area surveyed.
- 9.7 Details of trees with their name, numbers and girths shall also form part of the survey report.

9.8 The survey report should also cover the following:

General site observation such as location of access Roads River and nallah courses, irrigation canals etc.& presence of any well and/or tube well in the site or adjoining areas and water level in them. Also indicate likely ground water table in the area form local enquiry. Whether there is any rock outcrops within 1 km. from the site. Details of earlier uses of the site i.e. mining, quarrying, agriculture etc.Existing drainage pattern of the site, possibility of water logging and high flood level of the area.

9.9 Final survey report shall be submitted in 5 copies of standard A4 size sheets properly bound and printed using good quality paper and material.

10.0 INSPECTION

The Contractor shall make all arrangement of men, material and transport at the work site for checking of the work to the satisfaction of PFCCL or their authorized representative during the progress and on successful completion of the work. The Contractor shall intimate well in advance, before final decamping from work site, so that final work can be inspected by the PFCCL. This will form a part of acceptance of the wok for release of payments.

11.0 DEPLOYMENT OF RESORUCES

11.1 For the scope of work under the contract, as detailed in the specifications the Contractor shall mobilize adequate instruments so as to complete the work as per schedule. Additional instruments, if required, shall be mobilized to match the work schedule and as per the direction of PFCCL.

11.2 After arrival of the instruments at site, these shall not be moved out from the site by the Contractor without the prior written permission and approval of the PFCCL. In case the instruments are moved out from the site without the prior written permission and approval of PFCCL, PFCCL reserves the right to deduct from the Contractor's bill(s), the amount as considered reasonable and/or withheld payments for the work done. The decision of the PFCCL shall be final and binding in this regard.

11.3 The work at site shall be carried out under the full time supervision of a qualified engineer or a senior surveyor. The engineer or senior surveyor shall be responsible for and capable of coordinating the work of the surveying teams, setting out the work accurately and identifying immediately and positively the type of instruments to be deployed and change in the methodology of surveying to achieve speed and accuracy in the work, and shall be fully conversant with the theory and techniques of the traversing, triangulation, spot leveling survey work covered by this contract.

11.4 For the full, proper and continuous supervision of the work under the Contract, the Contractor shall engage and mobilize the necessary contingent of qualified and experienced manpower at site. The bidder should submit the details of the manpower to be deployed separately, which shall be subject to the approval of the owner.

11.5 Details of the actual staff shall be as per the requirement of the work.

12.0 DRAWINGS

The drawings shall be prepared directly on computers using standard software like AutoCAD-12/13 or Auto civil etc.

13.0 PROGRESS REPORT

13.1 The Contractor shall prepare and submit without fail to PFCCL progress report in three copies every fortnightly indicating status of setting out of the grids, total area surveyed, grid pillars constructed, methodology adopted for surveying and instruments deployed including staff working on the site and difficulties encountered during execution of the work etc.

13.2 The submission of such reports and review thereof by PFCCL shall not be deemed to absolve the Contractor of his responsibility of timely completion of the assignment as per the time schedule indicated.

14.0 TIME SCHEDULE

Time is the essence of the Contract. The Contractor shall strictly adhere to and complete all works as per the time schedule.

15.0 DECLARATION BY THE CONSULTANT REGARDING THE AVAILABILITY OF EQUIPMENT

The Contractor is required to give full information about the proposed deployment of the resources for this assignment.

CHAPTER-04

GEO-TECHNICAL INVESTIGATION

1.0 SCOPE

- 1.1 Detailed Geotechnical investigation to be carried out to provide the designer with sufficiently accurate information, both general and specific, about the substrata profile and relevant soil and rock parameters at site on the basis of which the foundations for various structures and equipments of the Power Station can be designed rationally. Such structures would include Main Power House, Boiler foundation, Turbo-generator foundation, Chimney, Foundations for rotary equipments, deep pits, etc. and all other related structures of the Power Station, Reservoir, Ash disposal area, Pipe-Corridors, Township, etc. The above list is indicative and not exhaustive. The consultant shall carry out the work as per the directives of Engineer-In-Charge to his satisfaction
- 1.2 This specification covers the technical requirements for a geotechnical investigation and submission of a geotechnical report. The work shall include mobilization of all necessary equipments (Annexure-A), providing necessary engineering supervision and technical personnel, skilled and unskilled labour, etc., as required to carry out the entire field as well as laboratory investigation, analysis and interpretation of data collected and preparation of a Geotechnical report. A technically qualified and experienced Geotechnical Engineer shall supervise the entire field as well as laboratory investigation work. A geologist shall also be deputed at site during investigation whenever rock drilling is undertaken. The scheduling of laboratory tests, analysis and interpretation of test results and a technically qualified and experienced Geotechnical Engineer shall also carry out drafting of report.
- 1.3 The Consultant shall make his own arrangements for locating the coordinates and positions of bore holes, trial pits, dynamic cone penetration tests and other field tests as per the drawings/sketches/co-ordinates supplied to him and for determining the reduced levels (R.L.'s) at these locations with respect to the single bench mark indicated by the Engineer. Two established reference lines will be indicated to him. The Contractor has to provide at the site all the required survey instruments to the satisfaction of the Engineer so that the work can be carried out accurately according to specifications and drawings.
- 1.4 All the field and laboratory data shall be recorded in the proforma recommended in Indian Standard Codes. The Engineer shall countersign all the field records soon after the completion of each bore hole/test. The Contractor shall submit to the Owner two copies of field borelogs (one copy to the site office of the Owner and the other to the Corporate Office). All the investigations are to be carried out by the agency as per the priority requirements of the Owner.
- 1.5 The Contractor shall intimate the Owner, giving reasons, if any additional specific tests he considers necessary to be carried out duly considering local soil conditions before starting of such tests.
- 1.6 Whenever the Contractor is unable to extract undisturbed samples he should immediately inform PFCCL. In such a case payment of boring charges shall be

subject to the owner being satisfied that adequate effort has been made to extract undisturbed samples.

- 1.7 All the laboratory test data shall be recorded in the proforma recommended in the Indian Standard Codes and a copy of these shall be sent to the PFCCL every week during the progress of laboratory testing. Whenever desired during the progress of the work the Owner may be present at the laboratory where the Contractor is arranging for execution of the laboratory tests.
- 1.8 The contractor shall interact with the PFCCL to get acquainted with the different types of structures envisaged and in assessing the load intensities on the foundations for the various structures of the Power project to enable him to calculate the allowable bearing pressure.
- 1.9 After the review of the draft report, the Owner's may call for discussions in order to explain to the Contractor the Owner's observation on the report. Within one week of such a request, the Contractor's technically qualified Geotechnical Engineer shall be available at PFCCL Office at New Delhi/Client's Office for a discussion. Any expenditure on account of redrafting, finalizing the report including cost of visits to PFCCL Office at Delhi shall be deemed to have been included in the quoted rates.
- 1.10 The Contractor shall carry out all work within para 1.0 of this Specification even if not explicitly mentioned under the Scope. All work shall be executed to the satisfaction of the PFCCL.

2.0 GENERAL REQUIREMENTS

- 2.1 In areas which have already been developed, the Contractor shall take advantage of existing local knowledge, records of trial pits, bore holes, etc., in the vicinity and the type of foundations adopted and behavior of existing structures, particularly those of similar nature to the ones proposed for this project.
- 2.2 The Contractor shall make use of information gathered from quarries, unlined wells, cuttings from nearby areas, etc. The general topography of the nearby areas will often give some indication about the variation of the soil conditions, which are likely to exist.
- 2.3 The Contractor shall gather data regarding the removal of overburden by excavation, erosion or landslides, etc. in the areas. Similarly, data regarding recent fills shall also be studied to determine the characteristics of the fill as well as the original strata.
- 2.4 The water level in streams and watercourses, if any, in the neighborhood shall be noted. Reliable information regarding ground water level shall also be gathered from water level in the wells nearby.
- 2.5 The Contractor shall make enquiry and verify regarding earlier use of the site, which can have important bearing on its suitability for the proposed structures. This is important, particularly in areas where there have been underground works e.g. worked out ballast pits, quarries, old brickfields, mines, mineral workings, etc. The possibility of damage to the structures, sewers, conduits and drainage system by subsidence shall also be investigated.

- 2.6 It is essential that the equipments/instruments be properly calibrated at the commencement of the work so that they represent true values and submit the test reports to Engineer. If the Engineer so desires, the Contractors shall arrange for having the instruments tested in presence of the Engineer at an approved laboratory at his cost and the test reports shall be submitted to the Engineer.
- 2.7 No claim whatsoever shall be entertained for differences between the extent, location, depth, etc. of soil test indicated on the construction drawings and those shown on the tender drawings, if any.
- 2.8 When blasting with explosives is involved, agency/contractor shall arrange statutory clearance and also the portable magazine for storing /carrying the explosives. Only licensee shall handle these explosives.

3.0 CODES AND STANDARDS

- 3.1 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.
- 3.2 In case of conflict between this specification and those (IS code, Standards etc.) referred to herein, the former shall prevail.
- 3.3 All work shall be carried out as per the following Indian Standards and Codes:

IS:1080	Code of practice for design and construction of simple spread foundations.
IS:1498	Classification and Identification of Soils for general Engineering Purposes.
IS:1888	Method of Load test on Soils.
IS:1892	Code of practice for Subsurface Investigation for Foundation.
IS:1904	Code of practice for design and construction of foundations in Soils: General Requirements.
IS:2131	Method of Standard Penetration Test for Soils.
IS:2132	Code of practice for Thin walled Tube Sampling of Soils.
IS:2470 (Part-I)	Code of practice for design and construction of Septic Tanks.
IS:2720	Method of Test for Soils (Relevant Parts).
IS:2809	Glossary of terms and symbols relating to Soil Engineering.
IS:2810	Glossary of terms relating to Soil Dynamics.
IS:2911	Code of practice for designs and construction of Pile foundations (Relevant Parts).
IS:2950 (Part-I)	Code of practice for designs and construction of Raft foundation.
IS:3025	Methods of Sampling and Testing (Physical and Chemical) for Water used in Industry.
IS:3043	Code of practice for Earthing.
IS:4078	Code of practice for Indexing and Storage of Drill Cores.
IS:4434	Code of practice for In-situ Vane Shear Test for Soils.
IS:4453	Code of practice for Exploration by pits, Trenches, Drifts and Shafts.
IS:4464	Code of practice for presentation of Drilling information and Core description of Foundation investigation.
IS:4968	Method for subsurface Sounding for Soils - Dynamic

(Part-II) IS:4968	method using Cone and Bentonite slurry. Method for subsurface Sounding for Soils- Static Cone Penetration Test.
(Part-III) IS : 5313	Guide for Core Drilling Observations.
IS : 5529 (Part-I)	Code of practice for in-situ permeability Test-Test in Over burden.
IS : 5529 (Part-II)	Code of practice for in-situ permeability Test- Test in Bed rock.
IS : 6065	Recommendation for the preparation of Geological and Geotechnical maps for River Valley Project.
IS : 6403	Code of practice for determination of Allowable Bearing Pressure on Shallow foundation.
IS : 6926	Code of practice for Diamond core Drilling for Site Investigation for River Valley Projects.
IS : 6935	Method of determination of Water level in a Bore-Hole.
IS : 6955	Code of practice of subsurface exploration for Earth and Rockfill dams.
IS : 7422	Symbols and Abbreviations for use in Geological maps, sections and subsurface exploratory logs (Relevant parts).
IS: 8009	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads
(Part –I)	– Shallow foundations
(Part – II)	— Deep foundations.
IS : 8763	Guide for Undisturbed Sampling of Sands.
IS : 8764	Method for determination of point load strength index of Rocks.
IS : 9143	Method for the determination of unconfined compressive strength of Rock Materials.
IS : 9179	Method for preparation of Rock Specimen for Laboratory testing.
IS : 9198	Compaction Rammer for Soil Testing.
IS : 9214	Determination of Modulus of sub grade reaction in field.
IS : 9259	Specification for Liquid Limit apparatus.
IS : 9640	Specification for Split Spoon Sampler.
IS : 9669	Specification for CBR Mould and its accessories.
IS : 10050	Method for determination of Slake Durability Index of Rocks.
IS : 10060	Code of practice for subsurface investigations for Power House Sites.
IS : 10074	Specification for compaction mould assembly for Light and Heavy Compaction.
IS : 10108	Code of practice for sampling by thin wall sampler with Stationary piston.
IS : 10589	Equipment for determination of subsurface sounding of Soils.
IS : 10837	Specification of moulds for determination of Relative density and its accessories.
IS : 11229	Specification for Shear Box testing of soils.
IS : 11315 (Part-II)	Description of Discontinuities in Rock Mass – Core Recovery and Rock Quality.
IS : 12070	Code of practice for design and construction of shallow foundations on rocks.
IS: 13372	Part-I & II: Code of Practice - Seismic Testing of Rock Mass

4.0 FIELD INVESTIGATIONS – IN SOIL

4.1 Boring

4.1.1 General Requirements

- a) Bore holes shall be taken at specified locations to obtain information about the sub-soil profile, its nature and strength and to collect soil samples for strata identification and conducting laboratory tests. The minimum diameter of the bore shall be 150 mm and boring shall be carried out in accordance with the provisions of IS: 1892 as per this specification.
- b) All boreholes shall extend upto depths as directed by the Engineer. If the strata with Standard Penetration Test (SPT) 'N' value greater than 100 with characteristics of rock is met with, prior to the specified depth, the bore hole shall be advanced further by chiseling. Chiseling shall be continued for a maximum depth of 20 cms or upto 2 hours whichever is earlier. During chiseling rock fragments shall be collected. Identification of rock strata shall be on the basis of visual examination of SPT sample and rock fragments. After it is established that rock is met with, borehole shall be advanced further by drilling in rock as specified in clause 5 and core shall be collected. When the borehole is terminated in soil strata, an additional Standard Penetration Test shall be carried out at the termination depth.
- c) Casing pipe shall be used in the borehole to support its sides when a side fall is suspected to occur inside the borehole. When casing pipe is used, it shall be ensured that its bottom end is at all times less than 15 cms above the bottom of the bore hole and not below the level at which the test has to be conducted or sampling has to be done. In case of cohesion less soils the advancement of the casing pipe shall be such that it does not disturb the soil to be tested or sampled. The casing shall be advanced by slowly turning the casing pipe and not by driving.
- d) In-situ tests shall be conducted or undisturbed samples (UDS) shall be collected in the boreholes at regular intervals and at change of strata or as decided by the Engineer. Representative disturbed samples shall be preserved for conducting various identification tests in the laboratory. Water table in the borehole shall be carefully recorded and reported. **No water/drilling mud shall be added while boring above ground water table.** For cohesion less soil below water table, the water level in the borehole shall at all times be maintained slightly above the water table.
- e) **Borehole shall be cleaned using suitable tools up to the depth of testing or sampling, ensuring that there is minimum disturbance of the soil at the bottom of the bore hole.** The process of jetting through an open tube sampler shall not be permitted. In cohesive soils, the borehole may be cleaned using a bailer with a flap valve. Gentle circulation of drilling fluid shall be done when rotary mud circulation boring is adopted.
- f) On completion of the borehole, including the borehole in which special tests are conducted, the Contractor shall backfill all the boreholes as directed by the Engineer.

4.1.2 Auger Boring

Auger boring can be adopted in soft to stiff cohesive soils above water table. Augers shall be of helical or post hole type, which may be manually, or power operated. While boring, care shall be taken to minimize the disturbance to the deposits below the bottom of the borehole.

The cuttings brought up by the auger shall be carefully examined in the field and the description of all the strata shall be duly recorded. No water shall be introduced from the top while conducting Auger boring.

4.1.3 Shell and Auger Boring

Shell and Auger boring can be used in all types of soil free from boulders. For cohesion less soil below ground water table, the water level in the borehole shall always be maintained at or above the ground water level. The use of chisel bit shall be permitted in hard strata with SPT-N value greater than 100. Chisel bits may also be used to extend the borehole through local obstruction, such as old construction, boulders, etc. All other requirements in clause 4.1.2 shall apply for this type of boring also.

4.1.4 Percussion boring (Chiseling)

This method can be adopted in soil with gravel and boulders when the boring has to be done at a fast rate. This method consists of breaking of the strata by repeated blows from a chisel or drilling bit and bailing out the debris at intervals by adding water into the borehole. This method is not permitted unless otherwise specified.

4.1.5 Rotary Mud Circulation Boring

This method can be used in all types of soil below water table. In this method rotating the bit fixed at the bottom of the drill rod shall do boring. Proper care shall be taken to keep firm contact between the bit and the bottom of the borehole. Bentonite mud shall be used as the drilling fluid to prevent caving in of the borehole sides. Use of percussion tool shall be permitted in hard clays and dense sandy deposits.

4.2 Standard Penetration Test

This test shall be conducted in all types of soil deposits met within a bore hole, to find the variation in the soil stratification by correlating with the number of blows required for unit penetration of standard penetrometer. This test shall be conducted at 3.0 m intervals and every change of strata and as per the direction of the Engineer. The starting depth of performing SPT shall be between 1.0 and 2.0 M depth below ground level. This depth shall be staggered in alternate boreholes. The depth interval between the top levels of Standard penetration test and next undisturbed sampling shall not be less than 1.0 m. The specifications for the equipments and other accessories, procedure for conducting the test, presentation of test results and collection of the disturbed soil samples shall conform to IS: 2131.

This test shall be carried out by driving a standard split spoon sampler in the bore hole by means of a 650 N hammer having a free fall of 0.75 m. The sampler shall be driven using the hammer and for 450 mm. While driving the number of blows for

every 150 mm penetration and the penetration for every 50 blows shall be recorded. The number of blows for the last 300 mm drive shall be reported as N value. This test shall be discontinued when the blow count is equal to 100 and the penetration shall be recorded. Refusal shall be considered to be met with when the blow count is equal to or greater than 100. At the location where the test is discontinued the penetration and the number of blows shall also be reported. Sufficient quantity of disturbed soil samples shall be collected from the split spoon sampler for identification and laboratory testing. The sample shall be visually classified and recorded at the site and shall be properly preserved and labeled for future identification.

4.3 SAMPLING

4.3.1 General

- a) Sufficient number of soil samples shall be collected for reliable estimation of soil properties. The samples collected shall be either disturbed or undisturbed. Disturbed soil samples shall be collected for field identification and conducting tests such as sieve analysis, index properties, specific gravity, chemical analysis, etc. Undisturbed samples shall be collected to estimate the strength and settlement properties of the soil.
- b) All the accessories required for sampling and the method of sampling shall conform to IS: 2132. All the disturbed and undisturbed samples collected in the field shall be classified at the site as per IS: 1498.
- c) All the samples shall be identified with date, bore hole or trial pit number, depth of sampling, etc. It is also essential to mark an arrow pointing towards the top surface of the sample. Care shall be taken to keep the undisturbed soil samples and box samples vertically with the arrow directing upwards. The tube samples shall be properly trimmed at both ends and sealed with molten paraffin wax at both ends immediately after extracting the samples from the borehole and suitably capped on both sides.
- d) When the Contractor fails to collect the undisturbed soil sample at a specified depth the reason for the same shall be indicated in the bore log and the bore hole shall be advanced by 0.5 M. Subsequently, for cohesion less soil Standard Penetration Test shall be performed and for very soft cohesive soil field vane shear test shall be performed.
- e) Precaution shall be taken to ensure that there shall not be any change in moisture content and disturbance of the soil samples and they shall be placed in a temporary store at the end of the day's work. All the samples shall be kept over a bed of sand; jute bags saw dust, etc. and covered over on top with similar material. The bed and top cover shall be kept moist till they are properly packed in wooden boxes. The Contractor shall be responsible for packing and transporting of all the samples from site to the laboratory within seven days after sampling with proper protection against loss and damage.
- f) All the samples shall be packed in wooden boxes using sand, saw dust etc. all around the samples before transportation to laboratory for testing.

4.3.2 Disturbed sample

- a) Disturbed soil samples shall be collected in bore holes at regular intervals to provide complete description of soil profile and its variation. Jar samples weighing approximately 10 N shall be collected in bore holes at 0.5 m intervals starting from a depth of 0.5 m below ground level and at every identifiable change of strata to supplement the boring records. Samples shall be immediately stored in airtight jars or polythene bags and labelled with borehole number and depth.
- b) In elevated areas, if superficial material is available in plenty, then bulk samples from a depth of about 0.5 m below ground level shall be collected to establish all the required properties to use it as a fill material. Disturbed samples weighing about 250 N shall be collected at shallow depths and immediately stored in polythene bags as per IS: 1892. The bags shall be sealed properly and they shall be kept in wooden boxes.

4.3.3 Undisturbed Samples

In each borehole undisturbed sample shall be collected at every change of strata and at regular intervals of 3.0 m and as directed by the engineer. The starting depth of collection of UDS shall be between ground level and 1.0 m below ground level and as decided by the Engineer. The starting depth shall be staggered in alternate boreholes. In cohesive soils collection of UDS shall be preferred in place of SPT. The depth interval between the top level of undisturbed sampling and standard penetration test shall be at least 0.5m. Undisturbed samples shall be 100 mm dia and 450 mm length. Samples shall be collected in such a manner that the structure of the soil and its moisture content do not get altered. The specifications for the accessories required for sampling and the sampling procedure shall conform to IS: 1892 and IS: 2132. Undisturbed sampling in sand shall be done using compressed air technique mentioned in IS: 8763. Thin walled sampler shall be used to collect undisturbed samples by pushing the tube into the soil. The sampling tube shall have a smooth finish on both surfaces and minimum effective length of 450 mm. The area ratio of sampling tubes shall be less than 12.5%. However, in case of very stiff soils, area ratio upto 20% shall be permitted.

a) Undisturbed Sampling in cohesive soil

Undisturbed samples in soft to stiff cohesive soils shall be obtained using a thin walled sampler. In order to reduce the wall friction, suitable precautions such as oiling the surfaces shall be taken. The borehole shall be cleaned and the depth of sampling below the ground level shall be noted. The sampler shall then be attached to the bottom of the boring rods and lowered into the borehole. The sampler shall be pushed into the clay layer by hand or by jacking and soil sample of specified length shall be collected without disturbing the soil. The distance by which the sampler penetrates into the soil strata shall be checked. Care being taken to ensure that the sampler is not driven too far as this will compress the soil. The sampler shall be rotated to break the core at the bottom of the sampler and then steadily drawn up.

a) Undisturbed sampling using Piston sampler

Undisturbed samples in very loose saturated sandy and silty soils and very soft clays shall be obtained by using a piston sampler consisting of a sampling cylinder and piston system. In soft clays and silty clays, with water standing in the casing pipe, piston sampler shall be used to collect undisturbed samples. During this method of sampling expert supervision is called for.

The interior surface of the sampler shall be smooth, clean and corrosion resistant. Its cutting edge and the ring seals shall be inspected for wear and rejected if worn. Check shall be done to ensure that the moving parts of the sampler function freely before the sampler is lowered into the bore hole. While pushing the system into the soil and till the beginning of the sampling operations, the bottom of the piston shall be flush with the cutting edge of the sampler. At the depth of sampling, the piston should be fixed relative to the ground and the sampler cylinder shall be independently pressed down smoothly and continuously into the ground. If an obstruction is met, the

sampler shall be withdrawn and another sample taken after the obstruction is removed.

Accurate measurements of the depth of sampling, height of sampler, stroke and length of sample recovery shall be recorded. After the sampler is pushed to the required depth, both the sampler cylinder and piston system shall be drawn up together ensuring that there shall not be any disturbance to the sample which shall then be protected from changes in moisture content.

b) Undisturbed sampling in Cohesion less Soils

Undisturbed samples in cohesion less soils shall be obtained as per the procedure given in IS: 8763. Compressed air sampler shall be used to take samples of cohesion less soil below water table. Precautions shall be taken to clear the borehole before sampling. Thin walled tube samplers of 60 mm internal diameter shall be used. The height and other dimensions of the sampler shall be recorded before use. Proper care shall be taken to maintain the water level slightly above the ground water table before and during sampling operations. Immediately after the sample is obtained, the ends of the sample shall be waxed and capped to avoid moisture content changes.

4.3.4 Relaxation During Sampling

- a) The Sampler shall be pushed into the soil and driving of sampler shall be resorted to only when it cannot be pushed into the soil. This shall be done only with the permission of the Engineer and all the details about the same shall be recorded into the bore logs.
- b) In clays when N value is above 50, undisturbed samples may be replaced by standard penetration test.

4.4 Ground Water

4.4.1 One of the following methods shall be adopted for determining the ground water table in bore holes as per IS: 6935 and as per the instructions of the Engineer.

- a) In permeable soils, the water level in the borehole shall be allowed to stabilize after lowering it adequately by bailing. When the water level inside the borehole is found to be stable, the depth of water level below ground level shall be measured. Stability of sides and bottom of the borehole shall be ensured at all times.
- b) For both permeable and impermeable soils, the following method shall be suitable. The borehole shall be filled with water and then bailed out to various depths. Observations on the rise or fall of water level shall be made at each depth. The level at which neither a fall nor a rise is observed shall be considered as the water table elevation. This shall be established by three successive readings of water level taken at an interval of two hours.

4.4.2 In case any variation in the ground water level is observed in any specific boreholes, then the water level in these bore holes shall be recorded daily during the course of the field investigation. Levels in nearby wells, streams, etc. if any, shall be noted whenever these readings are taken.

4.4.3 If so called for, observation wells shall be drilled for the purpose of long term studies of the fluctuation in ground water levels and pressure. Either a Stand pipe or Piezo meter shall be installed in selected previously drilled or specially drilled boreholes covering the complete site area. These shall be at specified depths as per the specifications and instructions of the Engineer. Daily water level readings shall be recorded immediately following the installation upto the time of leaving the site. At the end of fieldwork, these installations shall be handed over in satisfactory working condition to the Engineer without disturbing their position so that the owner can continue further observations. It is important to install some Standpipes and Piezo meters prior to the coming monsoon, in order to record the local effects and variations in the ground water level during the period.

4.4.4 Stand pipes and Piezo meters shall consist of 19mm internal diameter rigid unplasticised (UPVC) tubing. All the joints in the tubing shall be made of coupling sleeves. The top of UPVC tubing shall be enclosed in a 75mm diameter galvanized steel pipe of 1.5m lengths having a galvanized steel screw cap with well-greased threads and the caps shall be tightened such that it would be impossible to loosen by hand. The lower end of the pipe shall have four legs of 6mm thick and 100mm long and welded to have projection of 25mm. The pipe shall be sealed into the ground with cement grout so that it does not rotate. The top end of the pipe shall project about 300 mm above ground level unless otherwise specified by the Engineer.

4.4.5 The perforated tubing for the porous element shall be surrounded by a response zone of well graded sand from 500 mm below to 150 mm above the lower end of the Stand pipe or Piezometer, and the bore hole above the response zone shall be back filled with natural soil or well graded sand. The latter shall compose of particles that vary in amount according to the size in such a manner that the void space formed by the larger particles can be filled by smaller size particles.

a) Stand pipe

Standpipes shall be installed to measure the water level in soils with high permeability such as sand and gravel. The standpipe shall consist of perforated tubing attached to the bottom of the UPVC tubing. The perforated tube shall be 150 mm long having perforation of diameter not greater than 1 mm.

b) Piezo meters

Piezo meters shall be installed to measure the pore pressures in soil with medium to low permeability. Piezo meters shall consist of a porous filter attached to the bottom of the UPVC tubing. The filter shall be 300 mm length and shall be placed in the borehole and sealed at top and bottom by grouting. Hydraulic Piezo meters with double line to be used to remove the air trapped in the system.

4.4.6 Sub-soil Water Samples

a) Sub-soil water samples shall be collected for carrying out chemical analysis. Representative samples of ground water shall be collected when it is first encountered in boreholes before the addition of water to aid boring or drilling. Water samples shall not be collected when bentonite slurry or mud has been used for drilling operations. If water has been added for drilling purpose or if

ground water has been diluted by surface rainwater, then the borehole shall be dewatered and water allowed to rise from which the sample may be taken.

- b) The sampling apparatus shall be such that the water at the desired depth can be collected directly without any disturbance and any change in the concentration of the constituents like dissolved gases, etc. Undue agitation shall be avoided. An ordinary suction pump with its suction end inserted upto the required depth in the borehole shall be used for this purpose.
- c) The sample shall be collected in a clean vessel and allowed to settle so that the supernatant liquid can be poured into a clean well-rinsed glass or polythene bottle. Sufficient quantity and number of samples shall be collected to carry out the chemical analysis and sent to a laboratory in airtight bottles with proper labeling. Chemical analysis of water samples shall include determination of pH value; turbidity; sulphate, carbonate, nitrate and chloride; presence of organic matter and suspended solids.
- d) In some cases constituents may be mixed and analyzed later as specified in the specific test methods. Chemical preservatives may be added to the sample for cases as specified in the test method/IS codes. This shall only be done if analysis cannot be conducted within an hour of collection and shall have the prior written permission and approval of the Engineer.

4.5 In-situ Permeability Test

4.5.1 In-situ permeability test shall be conducted to determine the water percolation capacity of overburden soil. This test shall be performed inside the bore hole/trial pit at specified depths or in each layer or as per the directions of the Engineer. The type of test shall be either pump-in or pump-out test depending on the subsoil and ground water conditions. Pump-in test shall be conducted whether ground water in borehole exists or not. Pump-out test shall be conducted to obtain data for dewatering purposes when ground water is met in the borehole. The specifications for the equipments required for the test and the procedure of testing shall be in accordance with ARE: 5529, Part-I. When it is required to carry out the permeability test for a particular section of the soil strata above the ground water table, bentonite slurry shall not be used while boring.

4.5.2 Pump-in Test

Pump-in test shall be conducted in the bore hole/trial pit by allowing water to percolate into the soil. Choice of the method of testing shall depend on the soil permeability and prevailing ground water level. Only clear water shall be used for conducting the test. Before conducting the test, the bore hole shall be cleaned as specified in par 5.1.1 (e). Water shall be allowed to percolate through the test section for sufficient period of time to saturate the soil before starting the observation.

a) Constant Head Method (in borehole)

This test shall be conducted in boreholes where soil has a high permeability. Water shall be allowed into the borehole through a metering system ensuring gravity flow at constant head so as to maintain a steady water level in the borehole. A reference mark shall be made at a convenient level, which can be easily seen, in the casing pipe to note down the fluctuations of water level.

Varying the quantity of water flowing into the borehole shall counteract the fluctuations. The elevation of water shall be observed at every 5-minute interval. When three consecutive readings show constant value, the necessary observations such as flow rate, elevation of water surface above test depth, diameter of casing pipe, etc. shall be made and recorded as per the proforma recommended in IS: 5529, Part-I, Appendix-A.

b) Falling Head Method (in bore hole)

This method shall be adopted for soils of low permeability and which can stand without casing. The test section shall be sealed by the bottom of the borehole and a packer at the top of the test section. If the test has to be conducted at an intermediate section of a pre-bored hole then, double packers shall be used. Access to the test section through the packer shall be by means of a pipe, which shall extend to above the ground level. Water shall be filled into the pipe upto the level marked just below the top of the pipe and water allowed to drain into the test section. The water level in the pipe shall be recorded at regular intervals as mentioned in IS: 5529, Part-I, Appendix-B. The test shall be repeated till constant records of water level are achieved.

c) Percolation Test (in trial pit)

Percolation test shall be conducted in the trial pit in areas where water/effluent is stored/discharged in ground level tanks. The loss of water due to percolation into the soil shall be estimated by the soil absorption capacity. This test shall be conducted in trial pits as per the procedure given in IS: 2470-Part-I, Appendix-A.

4.5.3 Pump-out Test

This test shall be carried out to determine accurate values of permeability of soil below water table. This test shall be conducted by continuous pumping out water from a well so as to maintain a steady water level at the desired depth in the well. Varying the quantity of water pumped out of the well shall counteract the fluctuations in water level. The specifications for the equipment and accessories required for performing the test, test procedure, field observations and reporting of results shall conform to IS: 5529, Part-I. The well shall be 400 mm dia perforated G.I./M.S. pipe to be installed in the well of 250 mm dia and observation pipes of 50 mm dia shall be installed at regular intervals along three radial lines extending from the well at 120 degrees to each other. Length of these pipes shall depend upon the ground level, estimated lowering of ground water table and the distance from the well. Sufficient number of observation pipes shall be installed along each of the radial lines so as to assess the zones of influence due to dewatering. Draw down depth in the well as specified in the drawings.

4.6 Trial pit

4.6.1 Trial pits shall be of minimum 2m x 2m size at the bottom so as to permit easy access for visual examination of walls of the pit and to facilitate sampling and in situ testing operations. Pits shall be upto 4.0m depths in all types of soils or at least 1.0m into rock or as per the directions of the engineer. Precautions shall be taken to ensure the stability of pit walls including provision of shoring, if necessary, as per IS: 4453. Precautions shall be taken to prevent surface water draining into the pit. Arrangements shall be made for dewatering if the pit is extended below water table.

Trial pits shall be kept dry and a ladder shall be provided for easy access to the bottom of the pit. In-situ tests shall be conducted and undisturbed samples shall be collected immediately on reaching the specified depth so as to avoid substantial changes in moisture content of the subsoil. Arrangements shall be made for barriers, protective measures and lighting necessary for the period the pits remain open.

4.6.2 A note on the visual examination of soil and rock strata shall be prepared. This should include the nature, colour, consistency and visual classification of the soil, thickness of soil strata, thickness of expansive soil, ground water table, if any, etc.

4.6.3 Undisturbed samples shall be collected at 1.0, 2.0, 3.0 m depth and at the termination depth in all the pits.

a) Chunk Samples

In cohesive soils, weathered rock undisturbed samples of regular shapes shall be collected. The samples shall be cut and trimmed to a suitable size (0.3 x 0.3 x 0.3 m). A square area (0.35 x 0.35m) shall be marked at the centre of the leveled surface at the bottom of the pit. Without disturbing the soil inside the marked area, the soil around this marking shall be carefully removed upto a depth of 0.35 m. The four vertical faces of the soil block protruding at the centre shall be trimmed slowly so that its size reduces to 0.3m x 0.3m. Wax paper cut to suitable size shall be wrapped uniformly and covered with two layers of thin cloth over all the 5 exposed surfaces of the soil block and sealed properly using molten wax. A firmly constructed wooden box of size 0.35 x 0.35 x 0.35m (internal dimensions) with the top and bottom open shall be placed around the soil block and held such that its top edge protrudes just above the surface of the block. The space between the soil block and the box shall be filled uniformly and tightly with moist saw dust. The top surface shall also be covered with sawdust before nailing the wooden lid to cover the box firmly taking care that the soil block is not disturbed. The area of contact between the bottom portion of the block and the ground shall be reduced slowly by removing soil in small quantities using small rods, so that the block can be separated from the ground slowly without disturbance. After inverting the wooden box along with soil block, the bottom portion shall be trimmed and covered with wax paper, cloth and sealed with molten wax. A wooden lid shall be nailed to the box after providing proper saw dust cushion below it. An arrow mark shall be made on the vertical face of the wooden box to indicate the top surface of the sample along with the coordinates, date and depth of sampling.

b) Tube Samples

Undisturbed tube samples may also be obtained by means of a 100 mm diameter sampling tube with a cutting edge. The sampler shall be slightly oiled or greased inside and outside to reduce friction. The sampler shall be pushed into the soil and while doing so, soil around the tube shall be carefully removed. In case it is not possible to push the sample, it may be driven by light blows from a "monkey".

4.6.4 After the completion of the test, sampling and visual examination, the pit shall be suitably backfilled as directed by the Engineer. Unless otherwise specified, excavated soil shall be used for this purpose.

4.6.5 In case it is not possible to collect undisturbed samples in the trial pit, in-situ density of soil shall be determined by the sand replacement method. The specifications, equipments, accessories required for the test and test procedure shall be as per IS: 2720, Part-XXVIII. No separate payment shall be made for this test.

4.7 Static Cone Penetration Test

Static cone penetration test shall be conducted to know the soil stratification and to estimate the various physical and engineering soil properties. Pushing shall advance the cone penetrometer and the static force required for unit penetration shall be determined. The test shall be conducted using a 200 KN capacity mechanically operated equipment upto the specified depth or refusal whichever is earlier. For this test, 'refusal' means meeting very hard strata, which cannot be penetrated at the rate of at least 0.3cm/sec even when the equipment is loaded to its full capacity. The specifications for the equipment and accessories required for performing the test procedure, field observations and reporting of results shall conform to IS: 4968, Part-III. At the ground level, pre-boring upto 0.5m depths shall be permitted if the overlying strata are hard. No extra payment shall be made for boring. Continuous record of the penetration resistance shall be maintained. On completion of the test, the results shall be reported in an approved proforma as in IS: 4968, Part-III, Appendix-A.

4.8 Dynamic Cone Penetration Test

Dynamic cone penetration test shall be conducted using bentonite slurry by driving a standard size cone attached to the bottom of a string of drill rods. The test shall be conducted upto the specified depth or refusal whichever is earlier. Refusal shall be considered when the blow count exceeds 150 for 300 mm penetration. The specification for the equipment and accessories required for performing this test, procedure, field observations and reporting of results shall conform to IS: 4968, Part-II. The driving system shall comprise of a 650 N weight having a free fall of 0.75 m. The cone shall be 65 mm diameter provided with vents for continuous flow of bentonite slurry through the cone and rods in order to avoid friction between the rods and soil. On completion of the test, the results shall be presented as a continuous record of the number of blows required for every 300 mm penetration of the cone into the soil in a suitable chart supplemented by a graphical plot of blow count for 300 mm. penetration vs. depth.

4.9 Vane Shear Test

Field vane shear test shall be performed inside the borehole to determine the shear strength of cohesive soils, especially of soft and sensitive clays, which are highly susceptible to sampling disturbance. This test shall be conducted by advancing a four-winged vane of suitable size (75 mm or 100 mm diameter as per the soil condition) into the soil upto the desired depth and measuring the torque required to rotate the vane. The specification for the equipments and accessories required for conducting the test, the test procedure and field observations shall correspond to IS: 4434. Test may also be conducted by direct penetration from ground surface. If the cuttings at the test depth in the bore hole show any presence of gravel, sand, shells, decomposed wood, etc., which is likely to influence the test results substantially, the test at that particular depth may be omitted with the permission of the Engineer. However, the test shall be conducted at a depth where these obstructions cease to occur. On completion of the test the results shall be reported in an approved proforma as specified in IS: 4434, Appendix-A.

4.10 Plate Load Test

- 4.10.1 Plate load test shall be conducted to determine the bearing capacity and load/settlement characteristics of soil / rock at shallow depth by loading a plane and level steel plate kept at the desired depth and measuring the settlement under different loads, until a desired settlement takes place or failure occurs. The specifications for the equipment and accessories required for conducting the test, the test procedure, field observations and reporting of results shall conform to IS: 1888. The Engineer shall as given in the drawing or as indicate the location and depth of the test. Undisturbed tube samples as specified in para 5.6.3 (b) shall be collected at 1.0 m and 2.5 m depths from the natural ground level for carrying out laboratory tests.
- 4.10.2 The size of the pit shall not be less than five times the plate size and shall be taken upto the specified depth. All provisions regarding excavation and visual examination of pit under para 5.6.1 and 5.6.2 shall apply here also.
- 4.10.3 If the ground water table is at a depth higher than the specified test depth, the ground water table shall be lowered and maintained at the test depth for the entire duration of the test. Dewatering shall be at the cost of the Contractor.
- 4.10.4 Unless otherwise specified, the reaction method of loading shall be adopted. Settlement shall be recorded from dial gages placed at four diametrically opposite ends of the test plate. The test plate shall be 600 x 600 mm size and at least 25 mm thick. The bottom of the pit shall be leveled before placing the plate in position for conducting the test
- 4.10.5 A seating load of 7 kN/m^2 shall be applied and after the dial gauge readings are stabilized, the load shall be released and the initial readings of the dial gauges recorded after they indicate constant reading. The load shall be increased in stages. These stages shall be 20, 40, 70,100, 150, 200, 250, 300, 400, 500, 600 and 800 kN/m^2 or as directed by the Engineer, under each loading, record of Time vs. Settlement shall be kept as specified in IS: 1888.

In case of cohesive soils each load increment shall be maintained until the settlement is less than 0.02 mm/min or 6 hours whichever is later. Dial gauge readings for settlement shall generally be taken at 1, 2.25, 4, 6.25, 9, 16, 25, 60, 90 and 120 minutes from the start of each stage of loading. Thereafter the readings shall be taken at hourly interval upto a further 4 hours and at two hours interval thereafter for another 6 hours.

Other than cohesive soils, each stage of loading shall be maintained for a minimum duration of one hour or till the settlement rate reduces to 0.02 mm/min. whichever is later. No extrapolation of settlement rate from periods less than one hour shall be permitted. The final loading shall be maintained for 24 hours. During unloading reading of dial gauge reading shall be recorded for each stage of unloading.

- 4.10.6 Loading shall be carried out in stages as specified above till one of the following conditions occurs.
- a) Failure of the soil under the plate i.e. the settlement of the plate at constant load becomes progressive and reaches a value of 40 mm or more.

b) Load intensity of 800 kN/m^2 is reached without failure of the soil.

4.10.7 Backfilling of the pit shall be carried out as per the directions of the Engineer. Unless otherwise specified the excavated soil shall be used for this purpose.

4.11 Cyclic Plate Load Test

This test shall be carried out to determine the dynamic soil properties required for the analysis of foundation subjected to dynamic loads. This test shall be conducted on similar lines as the ordinary plate load test. In additions, unloading shall also be done before such stage of loading. Test set up, load increment, maximum load intensity, recording of field data, etc., shall be as per para 5.10.

4.11.1 After each stage of loading, the load shall be removed in a minimum of two stages and as directed by the Engineer. After each stage of reduction of load, dial gauge readings and settlements shall be taken for at least one hour until the readings stabilize. Thereafter the next loading stage shall commence. Analysis of test data shall be reported as per IS: 5249.

4.12 Field California Bearing Ratio Test

This test shall be carried out to obtain the properties of soil required for the construction of roads. The equipments and accessories required for carrying out the test procedure, recording of observations and presentation of results should conform to IS: 2720 part XXXI. The test locations and depth shall be as specified in the drawings or as directed by the Engineer.

4.13 Electrical Resistivity Test

This test shall be conducted to determine the Electrical resistivity of soil required for designing safety-grounding system for the entire power plant area. The specifications for the equipments and other accessories required for performing electrical resistivity test, the test procedure, and reporting of field observations shall conforms to IS: 3043. The test shall be conducted using Wanner's four electrode method as specified in IS: 1892, Appendix-B2. Unless otherwise specified, at each test location, the test shall be conducted along two perpendicular lines parallel to the coordinate axes. On each line a minimum of 8 to 10 readings shall be taken by changing the spacing of the electrodes from an initial small value of 0.5 m upto a distance of 10.0 m.

4.14 Seismic Refraction Test

4.14.1 The test shall be carried out to establish the rock and soil profiles of varying density. The dynamic shear modulus of the soils shall also be obtained from the results of this test. The specification for the equipments and other accessories, procedure for carrying out the test, recording and analysis of results and their presentation shall conform to IS: 1892.

4.14.2 The test shall be carried out by inducing shock waves into the soil by striking a plate, placed on the ground surface with a hammer. The shock waves shall be picked up through geophones placed on the ground surface at regular intervals in line with the plate along a straight line. The time elapsed before the waves reach the geophones shall be recorded to an accuracy of one milli-second or better.

4.14.3 Distance between the shock point and the geo-phones shall be increased to cover a wider area. Alternatively, multiple geo-phones shall be used simultaneously using multiple channel seismographs to record the arrival time and intensity of the waves reaching the geophones. The spacing of the geo-phones shall be 5 m. As the distance between the geophones and the shocks producing point are increased, the time lapse for the waves passing through different underlying strata and reaching the geophone shall be recorded. The waveforms shall be recorded for each test using multi-channel seismograph.

4.14.4 The test shall be conducted along traverses in two orthogonal directions as per the drawing or the instructions of the Engineer. During testing, proper care shall be taken to avoid disturbance caused due to the movement of vehicles or other working operations around the test location. The type of wave (compression or shear) shall be analyzed properly using the data recorded during the test.

4.15 **Cross hole shear test**

This test shall be carried out generally in accordance with IS: 13372-1992 to establish the dynamic elastic properties of soil and rock.

In cross-hole shear test, the seismic waves should be generated inside one borehole (shot hole) and seismic waves are to be picked up in two adjacent receiver boreholes. The number and spacing of the boreholes shall be determined by the nature of the project so as to obtain good results. The boreholes shall be uncased in the portion carrying the geophones. However, it should be kept filled with water or drilling mud in order to ensure perfect contact between the borehole wall and the geophone. In case of cased hole preferably a low velocity material such as a high impact PVC should be used for casing and it is essential that it should be well grouted behind in order to make an intimate contact with wall material. The charge shall be installed within the borehole at depth as specified and the waves shall be picked up from the geophones installed at required depths in receiver boreholes. Knowing the travel time from shot hole to receiver hole, and corresponding distance, the velocity of the waves is determined which enables to estimate dynamic elastic modulus, shear modulus and Poisson's ratio.

In each receiver borehole, multiple geophones shall be provided at 3.0m intervals to cover the depth and various strata as specified and multiple channel seismographs shall record intensity of the waves.

4.16 **Pressure meter Test**

4.16.1 This test shall be conducted in bore holes at desired depth, to obtain the in-situ stress strain characteristics and strength parameters of soil/rock layer by measuring the deformation of the probe at different pressures of the volume meter. **The size of the borehole shall be compatible to the size of the pressure meter probe.** The location and depth of the test shall be as given in the drawing or as per the directions of the Engineer.

4.16.2 All precautions shall be taken to ensure a smooth bore hole of required diameter with minimum disturbance to the surrounding soil. In soft, loose and sensitive soils, the bore hole shall be predrilled deeper than the testing depth far enough so that the cuttings settling at the bottom of the bore hole shall not interfere with the test.

4.16.3 The equipment shall be calibrated for pressure losses (membrane correction/air calibration) and volume or radius changes (line calibration/thick wall rigid steel

cylinder test) before starting of test and at regular intervals as per the manufacturer's specification.

- 4.16.4 Maximum value of pressure correction shall not be more than 50% of limit pressure. The total volume losses in the system shall not exceed 0.5% of the static probe volume per 100 kPa. Volume correction may be neglected in soil if it is less than 0.1 % of probe volume per 100 kPa.
- 4.16.5 The test shall be performed by expanding a cylindrical probe to obtain a pressure vs. volume curve as specified in IS: 1892. The probe may be of Ax, Bx or Nx size. However, the size of the borehole shall be compatible to the size of the pressure meter probe. Hosepipe connecting the probe with the surface unit shall be of flexible tubing of single or coaxial type. The equipment should be able to reach a maximum pressure of 5000 kPa for testing in soil and 8000 kPa for testing in rock. The accuracy of measuring device shall be such that a change 0.2% of static probe volume or 0.1% of probe radius is measurable as specified in IS: 1892.
- 4.16.6 Probe shall be lowered down to the required depth as soon as the boring is completed so as to limit the expansion of soil due to release of stresses. A clamping device ensuring that it is not located at the interface of two different soil/rock layers shall hold the probe.
- 4.16.7 Pressure shall be increased in at least 20 equal stages as directed by the Engineer. At each stage the pressure shall be maintained for a period of at least 60 secs. and volume reading shall be taken for 7 to 14 minutes. The volume of water sent into the probe during this period shall be measured upto an accuracy of 0.01 Cu.m. In case the water level in the volumeter drops rapidly, it is necessary to close the volumeter valve quickly so that the reservoir does not empty and allow air or gas into the tubing.
- 4.16.8 Test shall be carried out in stages till one of the following conditions occurs:
- a) The volume of the probe is doubled
 - b) Ultimate failure of soil/rock occurs
 - c) Load intensity of 5000 kPa for soil and 8000 kPa for rock is reached without failure.
- 4.16.9 **If the shape of the uncorrected pressure vs. volume curve drastically varies from the ideal test curve, the test shall be repeated at no extra cost to the owner at a different depth as decided by the Engineer.**
- 4.16.10 On completion of the test all the results mentioned in clause 7.2 shall be reported.

5.0 FIELD INVESTIGATION - ROCK

5.1 Rock Drilling

5.1.1 General Requirements

Drilling in rock shall be done at specified location or as per the directions of the Engineer. Before commencing drilling, it shall be proved that characteristics of rock have been met with as mentioned in clause 4.1.1 (b). The starting depth of drilling in rock, as mentioned in clause 4.1.1 (b) shall be certified by the Engineer. The portion

drilled in rock shall be backfilled with cement and sand (1:3) grout. The drilling information shall be recorded in pro-forma as given in Table-C.

5.1.2 Equipment

- a) Core drilling shall be done by rotary motion using diamond bit. The feed or thrust to the drilling bit shall be actuated by hydraulic type. The equipment or set up shall be capable of recovering 75% of the drilled volume. The rotary core drilling equipment and procedure for drilling shall conform to IS: 6926. The equipment shall be provided with necessary facilities to regulate the spindle speed, bit pressure and water pressure during core drilling to get good core recovery.
- b) Drilling shall be carried out with NX size diamond tipped drill bits or impregnated diamond bit depending on the type of rock encountered. Double tube swivel core barrel of Type B conforming to IS: 6926 shall be used to ensure good core recovery and to pick up cores from all layers of rock. Suitable core catchers shall be used to ensure continuous and good core recovery.

5.1.3 Procedure

- a) The drilling fluid shall be clean water. Circulation of the drilling fluid shall be started before the core barrel reaches the bottom of the hole to prevent cuttings or sludge from entering the core barrel at the start of coring. Drilling fluid shall be circulated continuously down the hollow rods and the sludge conveying the rock cuttings to the surface shall be collected.
- b) When drilling through soft/weathered/fractured rock water circulation must be reduced so as to avoid shattering/breaking the core.
- c) The rotational speed of the bit (spindle speed) the amount of downward pressure applied on the bit (bit pressure) and water pressure shall be suitably adjusted and properly monitored so that the core is collected with least disturbance and avoid shearing of the Core from its base. Bit speed, bit pressure, water pressure for the type of bit for various rocks type shall be as given in Appendix A of IS: 6926.
- d) No drilling run shall exceed 0.75 m in length. This can be increased to 1.5 m provided the core recovery is observed more than 80% in two successive 0.75 m drill runs and on approval from Engineer. If the core recovery is less than 20% then SPT shall be performed before commencing the next drill run as explained in clause 5.3.
- e) If at any time a blocking of the bit or grinding of the core is indicated, the core barrel shall be immediately withdrawn from the borehole regardless of the length of drill run completed.

5.1.4 Observations

- a) The colour of return water at regular intervals, the depth at which any change of colour of return water is observed, the depth of occurrence and amount of flow of hot water, if encountered, shall be recorded.
- b) The depths through which a uniform rate of penetration was maintained, the depth at which marked change in rate of penetration or sudden fall of drill rod

occurs, the depth at which any blockage of drill bit causing core loss, if any, shall be recorded.

- c) Any heavy vibration or torque noticed during drilling should be recorded together with the depth of occurrence.
- d) Special conditions like the depth at which grouting was done during drilling, presence of artesian conditions, loss of drilling fluid, observation of gas discharge with return water etc., shall also be observed and recorded.
- e) During drilling operation, observation on return water, rate of penetration etc. shall be recorded on a pro-forma as given in IS: 5313, Appendix-A.

5.1.5 Core Samples

- a) Core samples shall be extracted by the application of a continuous pressure at one end of the core with the barrel held horizontally without vibration. Friable cores shall be extracted from the barrel directly into a suitable sized half round plastic channel section. Care shall be taken to maintain the direction of extrusion of sample same as that while coring to avoid stress reversal.
- b) Immediately after withdrawal from the core barrel, the cores shall be placed in a tray and transferred into boxes specially prepared for the purpose. The boxes shall be made from seasoned timber or any other durable material and shall be indexed on top of the lid as per IS: 4078. The cores shall be numbered serially and arranged in the boxes in a sequential order. The description of the core samples shall be recorded as per IS: 4464. Where no core is recovered, it shall be recorded as specified in the continuous record of core recovery and RQD to be mentioned in the core log as per IS: 11315 Part-II.
- c) The basic information for the description of rocks shall cover a) degree of weathering b) discontinuity spacing c) strength d) colour e) grain size f) structural condition, the mineralogy of the grains and cementing material g) rock name special features like major joint plane's features/laminations, faults, etc. shall also be indicated.

5.2 Permeability Test

Permeability test shall be conducted in bedrock inside the drilled hole by pumping in water under pressure to determine the percolation capacity of the rock strata. This test shall be conducted in encased and un grouted sections of the drill hole and the use of bentonite slurry drilling is strictly prohibited. Clear and clean water shall be used for the purpose of both drilling and testing. The equipments required and the procedure to be followed for conducting the test shall conform to IS: 5529, Part-II. The length of the test section shall be either 1.5m or 3.0m as per field conditions and the directions of the Engineer. The levels of water table, if any, in the drill hole shall be recorded and the drill hole shall be cleaned before starting the test. Depending upon the depth of the test section, single packer or double packer method shall be adopted. Care shall be taken to see that all joints and connections are watertight during the test.

a) Single Packer Method

This method shall be adopted when the bottom elevation of the test section is the same as the bottom of the drill hole and where it is considered necessary to know the permeability value during drilling itself. This test shall be useful where the full length of the hole cannot stand encased or un grouted. The packer shall be fixed at the top level of test section such that only the test section lies below the packer. Water shall then be pumped through a pipe into the test section under a required pressure and maintaining it till a constant quantity of water intake is observed. The amount of water percolating through the hole shall be recorded at every 5 minutes intervals. The test shall be repeated by increasing the pressure at regular intervals upto a pressure limit as specified in IS: 5529, Part-II. The details and observations during the test shall be suitably recorded in a proforma recommended in IS: 5529, Part-II, Appendix-B.

b) Double Packer Method

This method shall be used when the permeability of an isolated section inside a drill hole is to be determined. Packers shall be fixed both at the top and bottom of the test section such that their spacing is exactly equal to the length of the test section. The test shall then be conducted as specified in clause 5.2(a).

5.3 Standard Penetration Test

The relevant hardness of rocks shall be tested in boreholes and after every drill run of 0.75 m in rock if core recovery is observed less than 20% or as directed by Engineer. The test equipment and arrangement shall be conforming to IS: 2131. An initial seating of the blows shall be given and the number of blows for each 7.5 cm penetration to a total penetration of 45 cm shall be recorded. Penetration shall be recorded (to mm) for every 50 blows and test shall be stopped at total of 100 blows.

5.4 Plate Load test

The test shall be conducted as described under clause 4.10 for soil subject to the following changes. The test plate on the surface of the rock shall be of size 45 cm x 45 cm and at least 25 mm thick. The maximum load shall be 2500 kN per sq.m applied in stages for 25, 50, 100, 150, 200, 300, 400, 600, 800, 1000, 1500, 2000 and 2500 kN per sq.m under each load the time vs. settlement shall be recorded and plotted.

5.5 Pressure meter test

This test shall be conducted as described under clause 4.16 for soil, subject to the following changes. The test shall be carried out till one for the following condition occurs:

- a) The volume of the probe is doubled
- b) Ultimate failure of rock
- c) Load intensity of 8000 kN/m² is reached without failure.

6.0 LABORATORY TESTING

6.1 Essential Requirements

- a) All laboratory tests shall be conducted in an approved laboratory using approved apparatus complying with the requirements and specification of Indian Standards or other approved standards for this class of work. It shall be checked that the apparatus are in good working condition before starting the laboratory tests. Calibration of all the instruments and their accessories shall be done carefully and precisely.
- b) Depending on the type of sub strata encountered, appropriate laboratory tests shall be conducted on soil and rock samples collected in the field. Laboratory tests shall be scheduled and performed by qualified and experienced personnel who are thoroughly conversant with the work. Tests indicated in the schedule of items shall be performed on soil, water and rock samples as per relevant IS Codes indicated in para 4.0. One copy of all the laboratory test data records shall be submitted to the Owner progressively every week. Laboratory tests shall be carried out concurrently with field investigation since initial laboratory test results could be useful in planning the later part of field work. The Contractor shall establish a schedule of laboratory tests and the same shall be submitted and got approved by the Engineer before starting of laboratory tests.
- c) All samples, whether undisturbed or disturbed, shall be extracted, prepared and examined by competent personnel, properly trained and experienced in soil sampling, examination, testing and in using the apparatus as per the specified standards.
- d) Undisturbed soil samples retained in liners or seamless tube samplers shall be taken out without causing any disturbance to the samples using suitably designed extruder just prior to actual testing. If the extruder is horizontal, proper support shall be provided to prevent the sample from breaking. For screw type extrudes, the pushing head shall be free from the screw shaft so that no torque is applied to the soil sample in contact with the pushing head. For soft clay samples, the sample from tube shall be cut by means of a high speed hacksaw to specified test length and placed over the mould before pushing the sample into it with a suitable piston.
- e) While extracting a sample from a liner or tube, care shall be taken to see that its direction of movement is the same as that during sampling to avoid stress reversal.
- f) On all undisturbed soil samples tested for bulk density, water content, grain size distribution, liquid limit and plastic limit tests shall also be performed.
- g) On all rock samples tested for unconfined compression test, bulk density, water absorption, point load index tests shall also be performed.

6.2 Tests

Tests as indicated in this specification and as called for by the Engineer shall be conducted. These tests shall include the following:

a) Tests on Undisturbed and Disturbed Samples

- Visual and Engineering Classification
- Sieve Analysis and Hydrometer Analysis
- Liquid, Plastic, and Shrinkage limits
- Specific Gravity
- Chemical Analysis
- Swell pressure and Free Swell index determination
- Proctor Compaction test
- California Bearing Ratio

b) Test on Undisturbed Samples

- Bulk Density and Moisture Content
- Relative Density (for sand)
- Unconfined Compression Test
- Box Shear Test (in case of cohesion less and $c-\phi$ soil)
- Tri axial Shear Tests: (depending on the type of soil and field conditions on undisturbed or remolded samples)
 - i) Unconsolidated undrained.
 - ii) Consolidated Undrained Test with the Measurement of Pore Water Pressure.
 - iii) Consolidated Drained.
- Consolidation test.

c) Test on Rock Samples

- Visual classification
- Water Absorption, Porosity and Density
- Specific gravity
- Hardness
- Slake durability

- Unconfined compression test (both saturated and at in situ water content)
- Point load strength index
- Deformability test (both saturated and dry samples).

d) Chemical Analysis of Subsoil and Ground Water

6.3 Salient Test Requirements

- a) Remolded soil specimen, whenever desired, shall be fully reworked at field density and moisture content. For conducting CBR test and tri axial test for dyke/road material the sample shall be remolded to 95% of standard proctor density.
- b) Tri axial shear test shall be conducted on undisturbed soil samples, saturated by the application of backpressure. Only if the water table is at sufficient depth such that chances of it's rising to the base of the footing are meager or nil, the tri axial tests shall be performed on specimens at natural moisture content. Each test shall be carried out on a set of three test specimens from one sample at cell pressures equals to 100, 200 and 300 kN/Sq.m or as required depending on the soil conditions.
- c) Effective stress tri axial shear test could be either consolidated drained or consolidated un drained with pore water pressure measurement. The test shall be conducted at cell pressures of 100, 200 and 300 kN/Sq.m ensuring complete consolidation at each stage.
- d) Direct shear test shall be conducted on undisturbed soil samples. The three normal vertical stresses for each test shall be 100, 200 and 300 kN/Sq.m or as required as per the soil conditions.
- e) Consolidation test shall have loading stages of 10, 25, 50, 75, 100, 200, 400 and 800 kN/Sq.m. Rebound curve shall be recorded for all the samples by unloading the specimen at the in-situ stress of the specimen. Additional rebound curves shall also be recorded whenever desired by the Engineer.
- f) Chemical analysis of sub-soil shall include determination of pH value; carbonate, sulphate (both SO₃ and SO₄), chloride and nitrate contents; organic matter, chemicals salinity and any other chemicals harmful to the foundation material. The contents in soil shall be indicated as percentage (%).
- g) Chemical analysis of sub-soil water sample shall include the determination of the properties such as colour, odor, turbidity, pH value and Specific conductivity, both at 25 deg. C and chemical contents such as Carbonates, Sulfates (both SO₃ and SO₄), Chlorides, Nitrates, Organic matter and any other chemical harmful to the foundation material. The contents such as Sulphates, etc. shall be indicated as ppm by weight.

- h) The lab CBR test shall be performed on undisturbed and remolded sample for soaked and unsoaked condition.

7.0 REPORT

7.1 General

- a) On completion of all the field and laboratory work, the Contractor shall submit a draft report containing Geological information of the region, procedure adopted for investigation, field observations, summarized test data, statistical average parameters for each identified layer. The report shall include detailed borelogs, subsoil sections, field test results, laboratory observations and test results both in tabular as well as graphical form, practical and theoretical considerations for the interpretation of test results, the supporting calculations/ documents for the conclusions drawn, etc. Initially, the Contractor shall submit three copies of the report in draft form for the Owner's review. The abstract of the sub-soil stratification of the project shall also be included in the report.
- b) The Contractor's qualified Geotechnical engineer shall visit the Owner's Corporate Office for a detailed discussion on the draft report based on the comments of the Owner. During the discussions, it shall be decided as to the modifications that need to be done in the draft report. Thereafter the Contractor shall incorporate in the report the agreed modifications as suggested by the Owner and submit the revised draft report for Owner's approval. Upon Owner's approval, the final report shall be submitted in five hard copies. The approved report shall also be submitted on two 3.5" floppy discs and three computer compatible compact discs (CDs).
- c) The detailed final report based on field observations, in - situ and laboratory tests shall encompass theoretical as well as practical considerations to arrive at foundations of different types of structures envisaged in the area under investigation. The Contractor shall acquaint himself about the type of structures, foundation loads and other information required from the Engineer.

7.2 Data to be furnished

The report shall also include but not be limited to the following:

- a) A plot plan showing the locations and reduced levels of all field tests e.g. bore holes, trial pits, static cone penetration tests, dynamic cone penetration tests, plate load tests, etc., properly drawn to scale and dimensioned with reference to the established grid lines.
- b) Geological information of the area such as geomorphology, geological structure, lithology, stratigraphy and tectonics faults, seismicity of the region and site, core recovery and rock quality designation, etc.
- c) Past observations and historical data, if available, for the area or for other areas with similar soil profile with similar structures in the surrounding areas.

- d) A true cross section of all individual boreholes and trial pits with reduced levels and coordinates showing the classification and thickness of individual stratum, position of ground water table, various in-situ tests conducted and samples collected at different depths and the rock stratum, if met with. All soil profiles shall be presented using any latest software package.
- e) A set of longitudinal and transverse soil/rock profiles vertical scale 1:200, horizontal scale 1:2000 connecting various bore holes in order to give a clear picture of the various of the subsoil strata as per IS: 6065.
- f) Water level contours and Rock level contours shall be presented in any latest software package.
- g) Plot of Standard Penetration Test (N values both uncorrected and corrected) with depth for identified areas.
- h) Results of all laboratory tests summarized (i) for each sample (as per Table-1 and Table 2 for soil and rock respectively) as well as (ii) a consolidated table giving the layer wise soil and rock properties in a format similar to Table 1 and 2. All the relevant charts, tables, graphs, figures, supporting calculations, conclusions and photographs of representative rock cores and trial pits shall be furnished.
- i) For all triaxial shear tests, stress v/s strain diagrams as well as Mohr's circle envelopes shall be furnished. If backpressure is applied for saturation, the magnitude of the same shall be indicated. The value of modulus of elasticity, E shall be furnished for all tests along with relevant calculations.
- j) For all consolidation tests, the following curves shall be furnished:
 e vs. log P (with Pre consolidation pressure marked on the curve)
 e vs. P and compression vs. log t or compression vs. square root of t (depending upon the shape of the plot for proper determination of coefficient of consolidation). The point showing the initial condition (e_0 , P_0) of the soil shall be marked on the curves.
- k) Values of compression index, coefficient of volume compressibility shall be furnished. The procedure adopted for calculating the compression index from the field curve and settlement of soil strata shall be clearly specified. The time required for 50% and 90% primary consolidation along with secondary settlement, if significant, shall also be calculated.
- l) Pressure meter tests, the following shall be furnished:
 Calibration Record including:
 Description of membrane and sheath on probes Dimensions of thick walled cylinder, Length of flexible tubing, Calibration curves, Temperature.
 Drilling Record including: Borehole number, Method of making borehole, log of soil type and condition, Depth of water in borehole, weather and temperature.

Test Record:

Type of test, Date and time, Depth of Center Point of probe, Volume readings at 30 and 60 second elapsed time and corresponding pressure readings. Notes on any deviation from standard test procedure.

Field Pressure meter, creep and air calibration curves indicating P_0 , P_f and P_l . Corrected pressure meter and creep curves indicating P_0 , P_f , P_l , along with calculation for the corrections.

- m) Values of cohesion, angle of internal friction, pressure meter modulus, shear modulus and coefficient of sub-grade reaction along with sample calculation. Calculation for allowable bearing pressures and corresponding total settlements, for shallow foundations mentioned in para 8.3 (b) and load capacity calculation of piles in various modes.

7.3

Analysis and Discussion of Results

The following details and data shall be furnished in the report.

- a) Analysis of results, comparison of field and laboratory data, discussion of results, statistical average of soil parameters, viz. engineering and physical, for each identified layer.
- b) For shallow foundations necessary information shall be provided to arrive at the following:
 - i) Net safe allowable bearing pressure for isolated square footings and continuous strip footings of sizes 1.0 to 5.0m at different founding depths of 1.0 to 4.0m, below ground level considering both shear failure and settlement criteria.
 - ii) Net safe allowable bearing pressure for raft foundations of widths greater than 6 m at 2.0, 3.0 and 4.0 m depth below ground level considering both shear failure and settlement criteria.
 - iii) Modulus of sub grade reaction, modulus of elasticity from plate load test results along with time settlement curves and load settlement curve in both natural and log-log graph.
- c) For piling necessary information shall be provided to arrive at the following:
 - i) Type of pile.
 - ii) Suitable founding strata for the pile.
 - iii) Estimated length of pile for 500 kN (400 mm dia), 750 kN (450 mm dia), 1000 kN (500 mm dia) and 4500 kN (1070 mm dia) capacities along with relevant sample calculation.
 - iv) Magnitude of negative skin friction, if any.

- d) Coefficient of permeability of various sub soil and rock strata based on in-situ permeability tests.
- d) Cone resistance, frictional resistance, total resistance and settlement analysis for different sizes of foundation as specified in para 7.3 b (i) based on static cone penetration test.
- e) Electrical resistivity of sub-soil based on electrical resistance tests including electrode spacing vs. commutative resistivity curve.
- f) Dynamic soil properties such as dynamic shear modulus, Poisson's ratio based on cross-hole shear and seismic refraction test data.
- g) Suitability of the soil for construction of roads and pavements, their stable slopes for shallow and deep excavations, active and passive earth pressures at rest and modulus of elasticity as a function of depths for use in the design of underground structures.
- h) Suitability of locally available soils at site for filling and back filling purposes.
- i) If expansive soil is met with removal/retainment of the same under the structures/roads etc. shall be given. In the latter case, detailed specifications of any special treatment required including specifications for materials to be used, construction method, equipments to be deployed, etc. shall be furnished.
- j) Chemical nature of soil and ground water with due regard to potential deleterious effects on concrete, steel and other building materials, etc. shall be dealt in detail.
- k) Susceptibility of sub soil strata to liquefaction, if any, in the event of an earthquake.
- l) Any other information of special significance like dewatering schemes, etc.
- n) Any additional soil investigation, if required, and if the Contractor considers such investigation to be necessary, the same shall be done free of cost.

8.0 SCHEDULE OF QUANTITIES AND MEASUREMENTS

8.1 Schedule of Quantities

- a.** The items of work in the Schedule of Quantities (Annexure C) describe the work very briefly and are indicative only.
- b.** The contractor will carry out all works within para 1.0 of this specification even if not explicitly mentioned under the scope and Schedule of Quantities. The various items of the Schedule of Quantities shall be read in conjunction with the

corresponding sections in the technical specifications including amendments and additions, if any.

- c. The lump sum rates quoted for Geo-technical investigation shall include minor details which are obviously and fairly intended, and which may not have been included in these documents but are essential for the satisfactory completion of the work.
- d. The bidders quoted rates shall be inclusive of providing all plant equipments, men, materials, skilled and unskilled labour; making observations, mobilization of men and materials, establishing the ground level and coordinates at location of each bore hole, test pit, etc., by carrying levels from one established bench mark and distances from one set of grid lines furnished by the Owner. Also, no extra payments shall be made for conducting the Standard Penetration Test; collecting, packing, transporting of all samples and cores; recording of all results and submitting them in approved formats.

8.2 Measurements

- 8.2.1 All measurement shall be in SI units.
- 8.2.2 Length shall be measured in meters (m) correct to two places of decimals. Areas shall be worked out in square meters (m².) and volume in cubic meters (m³), rounded off to two decimals.
- 8.2.3 Certain tests have to be conducted in boreholes, trial pits, etc. Such bore holes, trial pits, etc., shall be measured only once and not again just because tests are conducted therein.
- 8.2.4 The depth of penetration due to SPT at the bottom of borehole shall not be considered for the measurement of borehole depth.
- 8.2.5 Measurement for the item of pump out test shall be done in numbers.
- 8.2.6 Pits shall be measured in m³.
- 8.2.7 Pre boring done for carrying out Static Cone Penetration Test shall not be measured.
- 8.2.8 Coring in rock with diamond bit shall be measured in length in metres (m) correct to two places of decimal for the actual cored length satisfying the criteria of clause 4.1.1 (b), 5.1.1 & 5.1.2.

9.0 Deployment of Resources

- 9.1 Equipment and Accessories
- 9.2 For the scope of work under the contract, as detailed in the schedule of items, the contractor shall mobilize adequate resources and the equipment and manpower to be deployed / mobilized shall be indicated in annexure-A and B respectively.
- 9.3 The contractor shall give full information about the proposed deployment of resources for this assignment.
- 9.4 Additional equipment shall be mobilized, at no extra cost to the Owner as and when required as directed by the Engineer to match work schedule.

9.5 After the arrival of the equipments at site, they shall not be moved out of the site by the contractor without the prior written permission and approval of the Engineer. In case the equipment are moved out of site without permission and approval of the Engineer, the Client reserves the right to deduct from the contractor's bills, the amount considered reasonable and/or withhold the payments for the work done. The decision of the Engineer shall be final and binding in this regard.

Table- 1

SUMMARY OF LABORATORY TEST ON ROCK CORE SAMPLES

BORE HOLE NO.
DEPTH
CORE PIECE NO.

MOISTURE
CONTENT%

SPECIFIC
GRAVITY
HARDNESS
POROSITY

DRY DENSITY
KN/M³

SLAKE DURABILITY
TEST

POINT LOAD
STRENGTH INDEX

DEFORMABILITY
TEST

DRY SATURATED

UNCONFINED
COMPRESSIVE
STRENGTH
IN-SITU/SATURATED

CORE DESCRIPTION

REMARKS

LIST OF EQUIPMENTS TO BE MOBILISED TO SITE (MINIMUM)

Sl.No.	Description	Quantity (to be indicated by the bidder)
1.	Shell and auger boring set	
2.	Rotary core drilling unit (Hydraulic feed)	
3.	Static cone penetration test Equipment – 20T capacity	
4.	Dynamic cone penetration test Equipment	
5.	Plate load test set up	
6.	Field permeability test set up	
7.	Menard pressuremeter or equivalent set up with limit pressure of 80kg/sq.cm.	
8.	Seismic refraction and electrical resistivity test set up	

MINIMUM STAFF TO BE DEPLOYED

S.N.	Description	Number of persons (to be indicated by bidder)
1.	Geotechnical Engineer	
2.	Engineering Geologist	
3.	Supervisors	
4.	Qualified Surveyor	
5.	Rig Operators	
6.	Mechanic	

**SCHEDULE OF QUANTITIES FOR GEOTECHNICAL INVESTIGATION
INCLUDING LABORATORY TESTING**

Important Note:

1. The Bidders specific attention is drawn to Clause 8.0 (Schedule of Quantity and Measurements) of the specification. It will be understood that the bidder has fully studied the specification and Clause 8.0 in particular prior to quoting his rates.
2. All quantities given below are tentative and describe the work very briefly. The contractor will carry out all works within para 1.0 of this specification even if not explicitly mentioned under the scope and Schedule of Quantities.

Description	Unit	Qty
1. Making 150 mm nominal diameter boreholes at various locations in all types of soil including laterite using suitable approved method of boring including chiseling, cleaning, providing casing pipe as required or as directed; performing Standard Penetration Test at every 3.0 m interval and at change of strata; collection of water samples and disturbed soil samples, observation such as ground water, etc., collection of undisturbed soil samples at every 3.0 m interval and at change of strata; transportation of all the collected samples to the laboratory and back filling of boreholes on completion of the same, complete as per specification and instructions of the Engineer, for depths below natural ground level as given below:		
a) From natural ground level to 25.0 m depth or upto the hard strata of soil is met.	No.	08
b) From 25.0 m to 50.0 m depth or upto the hard strata of soil is met.	No	05
c) Beyond 50.0 m depth	M	Nil
d) Extra over item a, b, c, above for collecting undisturbed samples in sands using compressed air technique	M	Nil
3. Supplying and installing ground water level fluctuation measuring devices, recording daily variation of ground water table including compiling and submitting daily records, complete as per specification and directions of the Engineer. Cost of boreholes shall be paid for separately as per Item No.2		
a) Stand Pipes	M	Nil
b) Piezo meters	Each	Nil

Description	Unit	Qty
4. Excavating trial pits at various locations of size specified by Engineer upto 4.0 m depth in all types of soils and 1.0m depth in weathered rock which can be excavated with pick axe/crow bar, including sheeting or shoring the sides for the purpose of stability, dewatering and maintaining the pit dry at all times, handling, transporting and stacking of excavated material upto a lead of at least 50.0 m, collecting disturbed/undisturbed samples at 1.0 m intervals and conducting in-situ density tests at every 1.0 m intervals and at final depth, collecting water samples and transporting all soil and water samples to the laboratory, backfilling of the pit as per the directions of the Engineer, complete as per specification.	No.	02
5. Conducting field permeability test at various locations in bore holes or pits at various depths including providing packers as required, etc. as per specification and directions of the Engineer. Cost of bore hole and cost of pits, maintaining them dry and back-filling shall be paid for separately as per Item Nos. 2 and 4.		
a) Pump in test in borehole by constant head or falling head method.	Each	07
b) Percolation test in trial pit.	Each	05
6. Conducting Pump-out test below water table in a well, including preparation of well of 400 mm dia. installing 250 mm dia. G.I./M.S. pipes providing and installing observation pipes of 50 mm dia. at regular intervals along three radial lines all complete as per specification and directions of the Engineer.	Each	Nil
7. Performing Static cone penetration tests at various locations all complete as per specifications and instructions of the Engineer upto depth as specified on drawings.	M	200
8 Performing Dynamic cone penetration tests at various locations using 65 mm diameter cone (with circulation of bentonite slurry) all complete as per specification and instructions of the Engineer.	M	150
9. Conducting Field vane shear test at various locations and at specified depths including collection of disturbed soil samples at the test depth all complete as per specification and instructions of the Engineer.	Each	Nil

Description	Unit	Qty
<p>10. Conducting plate load test at various locations and depths all complete as per specification and directions of the Engineer. Payment for making the pit and maintaining it dry and backfilling, etc. shall be paid for separately as per Item No. 4.</p> <p>Plate load test</p> <p>a) Cycle Plate Load test</p> <p>b) Cyclic plate load test</p>	<p>Each</p> <p>Each</p>	<p>02</p> <p>Nil</p>
<p>11. Conducting field CBR tests at various locations, and depth, all complete as per specification and directions of the Engineer.</p>	<p>Each</p>	<p>Nil</p>
<p>12. Conducting Electrical resistivity tests at various locations all complete as per specification and directions of the Engineer.</p>	<p>Each</p>	<p>10</p>
<p>13. Conducting seismic refraction tests along various traverses all complete as per specifications and directions of the Engineer.</p>	<p>M</p>	<p>300</p>
<p>14. Conducting cross-hole shear wave test in bore holes in ash/soil/rock at specified depths including providing PVC liner to prevent bore-hole collapse and preparation of bore-hole upto the required depth of 25.0m, shifting of equipment from one test location to other, providing for labor, mobilization/demobilization, all complete as per specifications and instructions of Engineer.</p> <p>a) Preparation of borehole</p> <p>i) Boring in soil M</p> <p>ii) Drilling in rock M</p> <p>b) Generating wave in shot hole and measuring through geo-phones from receiver bore holes.</p>	<p>M</p> <p>M</p> <p>Each</p>	<p>Nil</p> <p>Nil</p> <p>Nil</p>
<p>15. Conducting pressure-meter test in boreholes at specified depth for soil or rock strata, including preparation of bore hole of required size compatible to that of pressure meter probe and upto required depth in all types of soil/rock strata, all complete as per specification and directions of the Engineer.</p> <p>a) Preparation of borehole</p> <p>i) Boring in soil M</p> <p>ii) Drilling in rock M</p> <p>b) Conducting test</p>	<p>M</p> <p>M</p> <p>Each</p>	<p>Nil</p> <p>Nil</p> <p>Nil</p>

Description	Unit	Qty
16. Core drilling in rock using hydraulic feed rotary drill and double tube core barrel with diamond bit including collection of core samples, performing SPT at locations where core recovery is less than 20%, maintaining continuous record of core recovery/RQD, keeping the cores in wooden core boxes, transporting to laboratory, back filling on completion of the same, all complete as per specification and instructions of the Engineer.	No.	01
(a) Extra for triple tube core barrel	No.	Nil
17. Conducting field Permeability test in rock in drill holes at various depths all complete as per specification and directions of the Engineer. Cost of borehole shall be paid for separately against item no. 2 and/or 16 for appropriate lengths.		
a) Single Packer Method	Each	05
b) Double Packer Method	Each	Nil

Description	Unit	Qty
18. Conducting various laboratory tests on soil samples at an approved laboratory including preparation of soil samples to determine the following properties of soil, all complete as per specification.		
a) Bulk Density and Moisture Content.	Each	50
b) Sieve Analysis	Each	100
c) Hydrometer Analysis	Each	50
d) Liquid Limit and Plastic Limit	Each	50
e) Shrinkage Limit	Each	10
f) Specific gravity	Each	20
g) Standard proctor compaction test	Each	5
h) Swell Pressure	Each	10
i) Free Swell Index	Each	20
j) Relative Density (for sand)	Each	02
k) Unconfined Compressive strength	Each	30
l) Direct Shear Test	Each	25
m) Triaxial Shear Test.		
i) Unconsolidated Undrained Test	Each	20
ii) Consolidated Undrained Test with Pore water Pressure measurementiii)	Each	05
Consolidated drained test	Each	05
n) One Dimensional consolidation test	Each	10
o) California Bearing Ratio	Each	02
p) Chemical Analysis	Each	10
19. Conducting chemical tests on water samples to determine the Carbonate, Sulphate, chloride, and Nitrate contents, pH value, turbidity, organic matter and any other chemicals harmful to foundation material, all complete as per specification.	Each	10

Description	Unit	Qty
<p>20. Conducting laboratory tests on rock samples including preparation of the samples to determine the following properties, all complete as per specification.</p> <p>a) Moisture content, porosity & Density</p> <p>b) Specific gravity</p> <p>c) Hardness</p> <p>d) Soundness</p> <p>e) Slake Durability index</p> <p>f) Unconfined compression test (both at saturated and in-situ water content)</p> <p>g) Point load strength index</p> <p>h) Deformability test (both saturated and dry samples)</p> <p>i) Impact Value</p>	<p>Each</p> <p>Each</p> <p>Each</p> <p>Each</p> <p>Each</p> <p>Each</p> <p>Each</p> <p>Each</p> <p>Each</p>	<p>20</p> <p>10</p> <p>10</p> <p>10</p> <p>10</p> <p>20</p> <p>10</p> <p>Nil</p> <p>Nil</p>
<p>21. Taking and providing photograph (by digital Camera) of rock cores, rock exposures and other Geological feature, pits, all complete as per the instructions of the Engineer (the rate shall include for providing five copies of each photograph in a set along with 3¹/₂" floppy.)</p>	<p>Set</p>	<p>10</p>

CHAPTER-05

SOCIO-ECONOMIC STUDY

1.0 THE AIMS AND OBJECTIVE OF THE STUDY:

- 1.1 The aim of the study is to assess the number of project affected persons (PAP,s) overall impact due to land acquisition and establishment of the project on the affected villages and its populace in general and the PAP whose livelihood is affected (directly or indirectly) due to land acquisition in particular. The study will also enumerate the number of PAP'S.
- 1.2 The objective of the study will be to establish base line condition assess the social-economic impacts due to land acquisition and project activities, establish the no. of impoverishment risk to find ,out the most vulnerable section of society and suggest the action which could be initiated immediately to address these issues and reduce impoverishment risks.
- 1.3 To achieve these objectives the consultant will cover the following aspects in the study.
- i) Establish a social-inventory of the affected villages.
 - ii) Social-economic impact-special mention should be given to women and SC/ST population.
 - iii) Impoverishment Risk Analysis of PAP.
 - iv) Identity indicators for monitoring the standard of living of PAP in future.
 - v) Presentation of all relevant information as ready reckons reference.

2.0 SCOPE OF WORK

In order to achieve the aim of the study it would be necessary to obtain the necessary details of PAP such as total land, land to be acquired by project, land left, production from the land, loss of income due to land less or loss of indirect income, movable, immovable assets etc. This would involve preparation of village's profiles and family/individual PAP profile for all the affected villages and families.

On the basis of the interpretation and analysis of the information and data collected through individual/family/village profiles, to prepare an appropriate R&R action plan for the rehabilitation of PAP's along with various community development activities.

2.1 SOCIAL INVENTORY:

This will include the social, cultural, economic, historical, political and environmental aspects. A detailed inventory of available infrastructure will be prepared. The economic base of the affected village and the PAP will be established. The social groups and the kinship among the villagers will be established. Tribal if any shall be categorized and described separately.

2.1.1 Village profile shall include the following apart from the other relevant socio economic data.

- i) Social/Infrastructural facilities such as roads, schools, community building health centers, sanitation works and electricity facilities etc.

- ii) Community/Social groups active in the area and their contribution towards betterment of local people PAP.
- iii) Role/Activities undertaken by the local authorities like the State Government Zila Parishad/Panchayat etc, in the upliftment /development of community. Also the development activities run by the Distt./State authorities in the area like IRDP Indira Awas Yojna, PM RojgarYojna- MNP etc.
- iv) Socio-political situation of the village.

2.1.2 The details of land as given below.

- i) Details of different types of land viz. revenue, forest, panchayat land etc. The amount of land under each category help by the PAP legally and by traditional and customary rights together with details of land belonging to each of these categories which is likely to be acquired
- ii) Details of land under different categories owned by PAP along with land owned/cultivated by them in other villages. The quality of land to be acquired and left with the PAP.
- iii) Resources base of the PAP including land, cattle, milk animal agricultural labour, other labours, self-employment, government service etc.

2.1.3 Details of affected persons access to source of fodder, firewood, potable water, irrigation, education and health care, post office, Telephone facility, Bank, Bus stop, Railway Station.

2.1.4 Cropping patterns of land holding PAP assessment/estimate of income from agricultural produce and the total income.

2.1.5 Identify the various funding agencies for development schemes that can be taken up through community organization such as Mahila/Yuvak Mandal among the PAP community.

2.1.6 Identifying the development schemes of the government such as IRDP, JRY, and PMRY and suggest possible age with the entitlement package in line with R&R policy.

2.1.7 Identify the vulnerable, women and aged PAP and those below the poverty line.

2.1.8 The study should also identify the tribal if any in the area and describe about them separately.

2.1.9 The details of chronic illness disease. Morality rate in the area.

2.2 **BASE LINE DATA**

2.2.1 Will establish the land to be acquired type of land, total production from the land, the increase in demand of specific goods and services the infrastructure and details of PAP due to acquisition of land.

2.2.2 In accordance with State Govt. R&R policy the project-affected person has been defined into the following categories and the study shall enumerate actual number of PAP category wise for each village.

- i) Displace families losing all land including homestead land.

- ii) Displaced families losing more than 2/3rd of agricultural land and homestead land.
- iii) Displaced families losing more than 1/3rd pf agricultural land and homestead land.
- iv) Displaced families losing only homestead land but not agricultural land.
- v) Families losing all agricultural land but not homestead land.

Classification of any effected person who is loosing livelihood but not covered in the above category will be discussed with PFCCL based on the loss of their livelihood.

2.2.3 The study should develop the profile of each PAP in order to monitor the development process.

2.2.4 The study should also ascertain the options of individual PAPs who adopt various rehabilitation measures and income generating schemes keeping in view their eligibility criteria. Total land requirement due to resettlement colony, infrastructure requirement, etc. has to be worked out on the basis of base line data and the application for acquiring the land is also to be submitted in consultation with the concerned department of Government of Bihar.

2.2.5 **INDIVIDUAL/ FAMILY PROFILE**

The individual/family profile of all the PAPs shall be in the following pattern so as to assess the present socio economic status of PAPs.

- i) Demographic details and occupations of the family- father, mother their children other dependants, single parents, particularly mother their children and those who live on their own and their classification in accordance with State Govt. categorization of project affected person.
- ii) Details of land under different categories owned and to be left with the family after land acquisition along with land owned/cultivated by them in either village, along with income for each category of land.
- iii) Resource base of family including land, cattle, milk, animal, agricultural labour, other labour, self-employment, government service.
- iv) Cropping patterns of land holding families and an assessment of income from agricultural produce.
- v) Patterns of income and expense of each family as a base for calculation of its income.
- vi) Details of Government grant loans etc received by the affected person under IDRP or any other such schemes.
- vii) The health status with specific detail of chronic diseases mortality and morbidity rate.
- viii) To estimate the household loss of production from the land due to land that is likely to be acquired by the project.

- ix) To assess the extent of possession of immovable properties like houses, wells, ponds, trees etc from the very household/PAP.
- x) To assess the employment potentials of the area with the help of educational status unemployed personnel available for work.

2.2.6 Assess the actual number of PAP s of each village and categories each PAP.

2.3 **IMPACT ASSESSMENT.**

2.3.1 Assess the impact of project activities on the base line social inventory. Assess the socio-economic impact of land acquisition and/or resettlement on the PAP. This should be indicated category wise.

2.3.2 Assess the impact of acquisition of different types of land which have been cultivated by PAP

2.3.3 Assess the total loss of assets it monetary value and loss of annual income/revenue to PAP community and village due to proposed project.

2.3.4 Assess the psychological impact on the PAPs as result of the displacement due to the project activities and suggest mitigatory measures. The attitude and reaction of PAPs towards the project may be described.

2.3.5 Assess the socio-economic impact of land acquisition and displacement or women their role in their family and the subsistence economy and suggest how these can be mitigated through the process of resettlement and rehabilitation or community development measures.

2.3.6 The status of MNP should be prepared. The government of India MNP should be compared with the affected village status to give a comparative status.

2.4 **IMPOVERISHMENT RISK ASSESSMENT (IRA)**

IRA will be carried out covering the following aspect

2.4.1 **LANDLESSNESS**

Expropriation of land removes the main foundation upon which people productive systems commercial Activities, and livelihoods are constructed. This is the principal form of de-capitalization and Pauperisattle of displaced people, as they lose both Physical and man-made capital.

2.4.2 **JOBLESSNESS**

Loss of wage employment occurs both in urban displacement and in rural areas and those losing jobs are landless laborers enterprise or service workers artisans and small businessmen. Yet creation of new jobs is difficult and requires substantial investment. Resulting unemployment or underemployment among resettles endures long after physical relocation has been completed.

2.4.3 **HOMELESSNESS**

Loss of housing and shelter may be only temporary for many displaced, but for some homelessness remains a chronic condition. In a broader cultural sense, homelessness is also the loss of a group's cultural space and identity resulting in a cultural impoverishment as argued by "Downing" and by students of place attachment. In a socio-spatial sense as argued by 'Chris de Wet', populations subjected to compulsory villagization schemes also experience a lasting sense of placelessness.

2.4.4 MARGINALIZATION

Marginalization occurs when families lose economic power and slide on a downward mobility path middle-income farm - households do not become landless, they become small landholders; small shopkeepers and craftsmen downsize and slip below poverty thresholds. Relative marginalization often begins long before actual displacement; for instance when lands are condemned for future flooding they are implicitly devalued as new public and private infrastructure investment are prohibited and the expansion of social service is undercut.

2.4.5 INCREASED MORBIDITY AND MORTALITY

Serious decrease in health levels result from displacement caused social stress insecurity, psychological trauma and the outbreak of relocation related illnesses particularly parasitic and vector-borne disease such as malaria and schistosomiasis. Unsafe water supply and poor sewerage system increase vulnerability to epidemic and chronic diarrhea, dysentery etc. The weakest segments of the demographic spectrum - infants, children and the elderly are affected most strongly.

2.4.6 FOOD INSECURITY

Forced uprooting increases the risk that people will fall into chronic undernourishment defined as a calorie-protein intake levels below the minimum necessary for normal growth and work and food insecurity.

2.4.7 LOSS OF ACCESS TO COMMON PROPERTY

For poor people particularly for the landless and asset less loss of access to common property assets that belong to relocated communities represents a major form of income and livelihood deterioration. Typically loss of common property assets is not compensated by government relocation schemes with only a few positive exceptions mainly in China.

2.4.8 SOCIAL DIS-INTEGRATION

Forced displacement tears apart the existing patterns of social organization, personal ties, and the enveloping social fabric kinship groups are often scattered local labour markets are disrupted and people cultural identity is put at risk. Life-sustaining informal social networks of mutual help, local voluntary associations self-organized service arrangements are dismantled and rendered inactive. This unraveling represents a massive loss of social capital incurred by the uprooted people. Yet this loss remains unqualified and uncompensated. Such "elusive" disintegration process undermines livelihood in ways unrecognized by planners.

2.5 IDENTIFICATION OF DEVELOPMENT INDICATORS

Identification of indicators to monitor the standard of living of PAP in future and the factors behind these indicators are to be detailed.

2.6 GENERAL

- 2.6.1 Computerization of the list of PAP along with the date of individual profile vis-à-vis land acquired compensation paid present address and income level etc. %age loss of income to the total income.
- 2.6.2 Assess educational profile of PAP and their potential for vocational training.
- 2.6.3 Any other relevant information found necessary so as to enable preparation of a suitable RAP.
- 2.6.4 The above information is to be analyzed and reported in a presentable manner.

3.0 METHODOLOGY

- 3.1 The study should use primary/secondary data as well as the demographic data already available with the revenue officials of the area, census records, land records voters list etc. In addition to generation a comprehensive enumeration of all PAP in the area, through door-to-door survey, the study should identify each individual in the categories that entitles him to a specific package of entitlement. Interview with PAPs and discussions with community, Govt. offices, and voluntary agencies of the area shall be an important part of the study.
- 3.2 For base line social inventory a structural questionnaire shall be developed for all affected villages and will be filled in by the consultant.
- 3.3 For individual profile a structured questionnaire shall be developed, agreed and administered to all the PAP of the project. The consultants will authenticate the data through cross verification and through other sources.
- 3.4 A participatory rural appraisal exercise with the involvement of affected persons in participatory mapping and modeling of the villages including its common resources and developmental infrastructure shall be an important aspect of methodology. The data specific to women activities and those having special needs should be clearly brought out in the study.
- 3.5 The data on Tribal their habits and profiles of community and individuals shall be separately spelled out.
- 3.6 All the data collected through the survey to be computerized on Dbase/Atlas GIS on village basis and the study as a whole.
- 3.7 The IRA will be addressed in a separate chapter based on the understanding and analysis of consultant.
- 3.8 All the data and information collected through the study could be analyzed and interpreted to enable PFCCCL to formulate an action plan together with a methodology for implementation. Data would be presented through tables and analyzed. Interpretation of

data and information are fundamental to the study and it is important that anthropologist/sociologists are involved in this. Such an approach would not only facilitate appropriate planning and speedy implementation of the project but also would result in the development of those affected by the project.

- 3.9 The interpretation should give equal weight age to qualitative and quantitative aspect so that a balance view of the impact of that acquisition, present need have affected persons and their choices are clearly brought out.
- 3.10 The social indicators will be addressed in the separate chapter.
- 3.11 The list of RAP along with individual profiles on land income skill etcbe presented as a part of the report.
- 3.12 The findings of the study shall be presented at a Workshop for discussion before the report is finalized.
- 3.13 The consultant will submit detailed methodology of the study including following details.
 - (a) Detailed structure of the responsibilities of chief coordinators, experts, supervisors and field staff.
 - (b) Name, qualification and experience of each staff involved in the study.
 - (c) The detailed programmed of study with time schedule for each staff and each activity and the proposed period of time to be spent at site.

4.0 REPORTING & MONITORING.

- 4.1 While carrying out the socio-economic study, the consultant should maintain close communication and should provide all reports to PFCCL. In addition at the end of the study before finalizing the same consultant should organize a workshop to present and discuss the results of the social-economic survey.
- 4.2 The weekly field study programmed shall be finalized and agreed with PFCCL within the overall time frame given in TOR. The weekly plan shall include the village houses to be surveyed and community meeting to be conducted. This shall be finalized along with the questionnaire within 30 days from the date of award.
- 4.3 A weekly progress report vis-à-vis the agreed weekly schedule shall be submitted to engineer in charge.
- 4.4 A monthly review meeting shall be held and minute along with the monthly report.
- 4.5 A table of contents on individual/family profile, village profile and social aspects shall be discussed and finalized before analyzing the results of the survey. This shall be done within 15 days of the field survey completed.
- 4.6 The consultant shall computerize the input and field data for each PAP and process the data.
- 4.7 The draft report and final report shall contain filled up formats, graphs, charts, mouza, maps, vicinity maps etc., highlighting various impact factors along with detailed analysis. Also the computer floppy of the data/report should be handed over to PFCCL by the consultant along with the original set of questionnaire etc.

5.0 TIME SCHEDULE:

The work shall be completed as per time schedule given in covering letter.

- 5.1 The staffing requirement and maydays requirement for socio-economic survey of PAP is to be submitted by the consultant along with the offer. Any deviation in the staffing or adjustment upwards or downwards in the maydays shall be mutually agreed between PFCCL and the consultant.
- 5.2 The weekly field study program shall be finalized and agreed with PFCCL within the overall time frame given in the TOR. The weekly plan shall include the village/no. of house to be surveyed and community meetings to be conducted.

6.0 BIDDING OFFER:

- 6.1 The Consultant will submit a detailed approach & methodology of the study, identify the secondary data sources, state the specific inputs required from the PFCCL and give the names of experts to be deployed for various fields like social, anthropological, economic, IRA, PRA, Computer etc. Along with the organization structure for the field study and manpower deployment schedule.
- 6.2 For other conditions please refer the Conditions of the Contract.

7.0 DELIVERABLES:

- 7.1 The consultant should furnish two sets of (1) questionnaire (2) Annotated Table of contents and (3) two sets of data in tabular form before submission of draft report for approval. Further 4 copies of draft report are to be submitted by you for approval. You shall furnish 15 (Fifteen) copies of the report with one copy for reproduction. Also 10 (ten) copies of report are to be submitted in local language. The raw data and the whole report is to be furnished on a floppy disc in format acceptable to PFCCL using the software like MS word, MS excel, Lotus 123, Dbase, Fox-pro only.
- 7.2 The draft report and final report shall contain filled up formats, graphs, charts, Mouza, Maps, vicinity Maps etc., highlighting various impact factors along with detailed analysis. Also the computer floppy of the data/report should be handed over to PFCCL by the consultant along with the original set of questionnaire etc.

CHAPTER-06

ENVIRONMENT IMPACT ASSESSMENT (EIA) STUDIES & MOEF CLEARANCE

1.0 OBJECTIVE:

In order to identify the environmental impacts due to the construction and operation of the power plant and associated facilities, an Environmental Impact Assessment (EIA) study is proposed to be undertaken. The aim of the study is to establish the existing environmental conditions, predict impacts of the power plant, suggest Environmental Management Plan with cost estimate and develop a post study-monitoring program. The EIA report is required for seeking Prior Environmental Clearance i.e. TOR approval and Environmental Clearance from Ministry of Environment & Forests/ State Pollution Control Board and No Objection Certificate from State Pollution Control Board and clearance from funding agencies wherever applicable.

2.0 SCOPE OF SERVICES:

The scope of services includes literature review, field studies, impact assessment and preparation of the EIA document covering the disciplines of Land Use, Water Use, Demography & Socio-economics, Geology, Soils, Sediments, Hydrology, Water Quality, Meteorology, Air Quality, Terrestrial Ecology, Aquatic Ecology, Noise and Occupational Health and Safety. Services include submission of executive summaries both in English and Hindi, Rapid EIA report (based on three months sampling data) and Comprehensive EIA report (based on 12 months data). The summary will cover concise discussions on significant findings and recommended actions. The Consultant will be required to present the report before Public Hearing meetings, State Pollution Control Board (SPCB) and Expert Appraisal Committee of the Ministry of Environment & Forests (MOEF), and submit all clarifications/replies to queries for obtaining No Objection certificate (NOC) from the State Pollution Control Board and environmental clearance from MOEF.

The study will comprise of the following stages:-

Stage 'A'	Determination of baseline conditions.
Stage 'B'	Assessing the impacts on the environment due to the construction and operation of the power plant and recommendations on preventive measures to be taken to minimise the impact on the environment to acceptable levels. A suitable post-study monitoring program will be outlined.
Stage 'C'	Preparation of EIA document.

The Consultant's offer shall indicate detailed methodology (including sampling procedures wherever applicable and sampling frequency) and plan of work for each area of study.

The parameters to be analyzed and the number of sampling locations indicated under various disciplines are only indicative. However consultant will determine the actual number of locations and parameters depending upon terrain, weather condition, water bodies, soil etc. Additional parameters and sampling locations should be clearly indicated separately along with justification and additional cost in the offer by the consultant. The scope of work along with additional activities as may be proposed by the consultant will be discussed and finalized before award. The location of sampling sites

will be finalized in consultation with Engineer-in-Charge (EIC). Any deviation from the agreed scope of services will be with the prior approval of the EIC. An outline of the activities to be undertaken for each stage is given below:

2.1 STAGE 'A':

The core area for the study will cover an area within 10-km radius around the project site. The general area of study will cover a 15-km radius around project site. However, the impact of other industries located beyond 10 km and up to 25 km likely to have an influence in the study area, should also be covered.

The consultant should identify industrial and infrastructural development plan proposed for the area from concerned agencies and indicate the overall impact of these plans on the environment of the study area. The policy, legal and administrative framework within which EIA is prepared will be included in the report.

2.2 Project Description

Concise description of the project's environmental, engineering and geographic features including any offsite facility that may be required will be covered in this section.

Data on the land requirement, forestland involved number of families likely to be affected and number of homestead oustees due to land acquisition need to be collected and highlighted in the interim and final report.

2.3 Baseline Data

The baseline environmental conditions will be established through literature survey and field studies/monitoring. In addition, information on the location of metropolitan cities, national parks, wildlife sanctuaries and ecologically sensitive areas like tropical forests, important lakes, biosphere reserves, within a 25 km. radius of the plant need to be furnished. The distance of the proposed site from the flood plain of the riverine system, and the highways is to be indicated. Places of archaeological, historical, cultural/religious/tourist interests, defence installations, etc. within a radius of 10 kms from the site are also to be identified. Nearest location of such places (may be beyond 10kms) should also be identified. All the above information should be presented on colored maps. Whether the area is flood, cyclone or earthquake prone is also to be mentioned.

A review and analysis of the information available with various Governments, educational and other institutions will be carried out for each discipline. Based upon preliminary review of the available data, detailed fieldwork will be planned to collect information on the parameters critical to characterize the environment of the area. Any change anticipated before the project commences should be included. Current and proposed development activities within project area (but not directly connected to the project) should also be considered.

The duration of field monitoring, wherever necessary, will be for a period of one year to accommodate monthly/seasonal variations. Data should be sufficient to develop a clear understanding of the nature and magnitude of potential impacts of the project. The baseline environmental studies will include following disciplines:

Land use, Water use, Demographic and Socio-economics, Geology, Soil, Hydrology (surface and ground), Water Quality (surface and ground), Sediments, Meteorology, Air Quality, Ecology (Terrestrial and Aquatic), Noise and market survey for potential ash utilization.

2.3.1 Land Use

The present land use pattern and its evolution in the last two decades is to be established through literature review, satellite imageries and field studies with respect to irrigated and non-irrigated agricultural land, barren stretches, pasture land, mines, forest

and human settlements etc. The land use pattern is to be presented on colored map. Current and planned activities will be defined, characterized and quantified for the site and surrounding area. Important archaeological, historical, cultural, aesthetics, religious and ecologically sensitive areas like National Park/Sanctuary/ Biosphere reserve within a radius of 25 km, if any, are to be identified.

The land requirement for the project including plant, township, ash disposal, corridors etc. is to be spelt out. The classification of land with respect to agricultural/forest/waste land/Govt. land/ Private Land, Revenue land should also be indicated.

2.3.2 Water Use:

The trend of surface and groundwater use for irrigation, industrial and domestic activities etc. for a decade are to be identified. The requirements for each of the above activities as well as the locations of water source will also be identified. Amount of water required by the project should also be mentioned and consequent impact of drawl of water and discharge of effluent on the downstream users should be identified and discussed. Areas of conflicts, if any, over water use will be identified.

2.3.3 Demography and Socio-economics:

A study of the existing population in the study area is to be conducted and its socio-economic characteristics and historical trends for the past two decades is to be determined through literature. The study will include assessment and characterization of population with respect to male and female ratio, educational pattern, religious beliefs, and family structure, and irrigation pattern, sources of livelihood, economic opportunities, public health and financial position of the population.

The study will also include availability of infrastructure facilities like health services, status of health and disease pattern in the study area, water supply, road and transport system, communication, sanitary facilities, schools, fire services, police station etc. Labour force will also be determined as available skilled and non-skilled workers as also the role of women.

The Rapid EIA Report shall necessarily include a field survey to identify the homesteads affected due to land acquisition for the project. Based upon Mouza map or any other available Govt. records, the approximate number of project-affected families (PAFs) due to acquisition of land is to be indicated in the report.

It needs to be established as to whether the project area falls under the category of scheduled tribes or MADA areas declared by the Government of India. The perception of the local population, NGO's and the project-affected families on the project is to be highlighted. This information will be reflected in both Rapid and final EIA reports.

2.3.4 Geology:

Brief geological history including the topography of the area will be brought out. Various stratigraphic formations, rock types, soil stability, structural features, weathering characteristics and seismic details will be studied in detail. A geological map and profile of the area will be developed. The geology of ash disposal areas will be studied in detail with respect to their location and possibility of ground water contamination due to leach ate.

2.3.5 Soils:

Significant Physico-chemical parameters of soil will be determined at ten locations during the pre and post monsoon seasons in the study area with respect to colour, texture, soil type, pH, conductivity, sodium absorption ratio, cat ion exchange capacity, N, P & K. The sampling locations for soil are to be judiciously chosen to represent the area characteristics based on geology and floristic pattern. Fertility of soil of plant and

township area will be brought out with respect to potential of developing green belt and a forestation.

The soil profile, characteristics and soil type of the plant, township and ash disposal area will be determined through survey. Soil profile at least of 5 feet depth would be provided at representative locations. In addition, borehole data for the ash disposal area will be determined at a minimum of ten locations. Infiltration tests shall be carried out at these locations in ash disposal area using concentric ring infiltrometer. The parameters to be analyzed include permeability, infiltration rate, water holding capacity, cat ions (Ca, Na, K), anions (Cl, SO₄, CO₃), heavy metals (Cd, Total Cr, hexavalent Cr, Ni, As, Pb, Zn, Cu, etc.).

2.3.6 Hydrology (Surface and Ground):

Existing hydrological data will be examined for completeness and consistency. Topography, drainage, flooding pattern and riverbed / bank erosion for major rivers is to be determined. The historical data of monthly water discharge (for the last decade) and lean season flow of water should be clearly brought out for major rivers. The nature of the streams, i.e., influent or effluent, shall be established. Based on runoff, evaporation, evapotranspiration and infiltration parameters, water budget will be determined for the area. A separate water budget for surface and ground water is to be prepared.

Aquifers are to be identified with respect to stratigraphical sequence. Data on changes in the ground water conditions during last 5 years, if available, is to be collected. The aquifer conditions (confined or unconfined) are to be characterized. The seasonal water table fluctuations should also be determined. The recharge-discharge of the area and the flow net of the area for pre and post monsoon period is to be presented.

Aquifer characteristics such as porosity, permeability, recharge and drawdown characteristics, and ground water flow rates and direction should be established through pump tests/boreholes drilled at about three appropriate locations. However, the consultant should satisfy himself of the adequacy of the number of boreholes required for generating the required data.

In case additional boreholes are required to be drilled, the Consultant shall also do the same. The additional boreholes shall, however, be drilled only after obtaining the confirmation from EIC for the same. The consultant shall include in his bid the cost of drilling three boreholes as expected to be drilled. The consultant shall also indicate in his bid separately the per meter charges of drilling of additional boreholes. The charges for drilling shall be inclusive of all components (e.g. materials, accessories, mobilization/demobilization and testing charges etc.) required to generate the required hydrological data.

2.3.7 Water Quality: (Surface and Ground)

The surface and ground water quality shall be monitored on monthly basis at a minimum of six locations in order to characterize the water bodies with respect to physico-chemical characteristics and pollution levels. The location and exact number of sampling points shall be decided in consultation with EIC. The parameters to be analyzed shall be as per notification of Ministry of Environment & Forests dated 19.5.1993 under Environmental (Protection) Rules, 1986. The monitoring frequency will be as per schedule indicated in Annexure-I.

2.3.8 Sediments:

Surface sediment samples from the sea, rivers and its major tributaries shall be collected from at least ten locations using a grab sampler and analyzed for metals and trace elements, chlorinated pesticides once in a year. The benthos shall also be

analyzed for species composition and biomass of main invertebrates. Sediment load of rivers and its tributaries is to be estimated.

2.3.9 Meteorology:

A fully instrumented continuous recording meteorological observatory will be designed, constructed and operated at the site for one year to measure the following parameters: temperature at 2m and 10m level, barometric pressure, relative humidity, wind speed and direction, solar intensity and duration, & rain fall. The schedule of meteorological measurements is given in Annexure-I.

In addition, rain water (monsoon and winter) will be collected and chemical analysis conducted for pH, Sulphates, Nitrates, Chlorides and Solids so as to adequately characterize the rain water. Weather phenomena like hail, thunder, storms, dust storms, fog/smog and cloud cover shall be noted in terms of their intensity and duration. Data on frequency of cyclones, tornadoes, and cloudburst in the area will also be collected.

However, for background purposes, past decades meteorological data including available data on inversion heights, frequency and duration of incidence from the nearest IMD observatory will be collected. Based on meteorological data wind roses (both seasonal and annual) will be prepared. A critical comparison between long-term meteorological data and one year meteorological data measured at site shall be made to finalize the input for mathematical modeling. Additional information regarding the terrain will be used to determine the adequacy of the meteorological conditions as well as to finalize the input for subsequent air quality modeling.

2.3.10 Air Quality:

A monitoring network for ambient air quality will be designed to characterize ambient air quality with respect to SO₂, NO_x, Suspended Particulate Matter (SPM) and Respirable Particulate Matter (RPM). Monitoring shall be conducted at a minimum of four appropriate locations. At each location, 24 hour sampling shall be undertaken twice a week for a period of one year. The monitoring schedule for ambient air quality is given in Annexure-1. The monitoring locations shall be selected based on a computer based mathematical air quality model suitable for the local condition. One of the locations will be up wind side, which would serve as reference point. The locations will be finalized in consultation with Engineer- in-charge.

2.3.11 Ecology:

The ecological study will aim to understand the 'state of health' of habitat and ecosystems such as degree of disturbance, presence of pollutants, nutrients and hazardous material. Type, locations and characteristics of important and sensitive flora and fauna will also be described.

2.3.11.1 Terrestrial Ecology:

Vegetation type will be defined through latest satellite imagery data and field investigation. This will be based on two appropriate seasonal sampling of vegetation for density, diversity, frequency, relative abundance, cover etc. The consultant has to clearly spell out the most abundant plant species based on these parameters. In addition, abundance of wild animals and birds will have to be estimated. Path of migratory birds, if any, is also required to be demarcated. A list of endangered species (both flora and fauna) is to be prepared. Presence of wet lands and other ecologically sensitive areas such as national parks/sanctuaries, if any, is to be identified and indicated on a map.

2.3.11.2 Aquatic Ecology:

The ecology of the water body/bodies likely to have impacts due to construction and operation of the project is to be thoroughly investigated. This effort will include review of existing literature and two seasonal field studies at a minimum of three locations. A list of flora and fauna shall be prepared. The water body/bodies shall be characterized for trophic status, areas of chemical and thermal pollution, primary productivity, and densities and diversities of phytoplankton, zooplankton, benthic macro invertebrates, fish and macrophytes. Diversity indices of these ecological groups will also be calculated.

The spawning and feeding habitats of aquatic species will be determined with respect to both time and location. Rare and endangered species are to be identified and listed.

2.3.12 Noise:

A noise monitoring survey, which will produce sufficient baseline data to characterize the noise environment in the various zones of study area like Industrial, Commercial, Residential and Sensitive locations shall be undertaken. The survey has to be undertaken at 10 locations for two seasons and for 24 hours at each location. The equivalent continuous noise level (Leq) has to be measured using an integrating sound level meter. Attenuation model will be developed to predict the noise level during construction and operation of the project in the surrounding areas.

2.3.13 Potentiality of Ash Utilization:

A market survey needs to be conducted through a structured questionnaire to quantify the demand of the ash and ash products in the area. An economic analysis is also to be conducted to establish the feasibility of economic use of the ash generated from the plant. The Consultant shall examine the feasibility of establishing a dedicated Cement plant in the vicinity of project to be ascertained. The details to be covered in the questionnaire for the survey will be finalized in consultation with the EIC. Ash utilization aspect with plan for 100% ash utilization is to be described both in Rapid and in the final report.

2.4 STAGE 'B':

2.4.1 Environmental Impact

The features of the power plant and other industries which are likely to have impact on the environment have to be discussed in detail covering gaseous emission, liquid effluents, particulates, solid wastes, noise, etc.

With knowledge of the baseline conditions and plant characteristics, positive and negative impacts during the construction and operation phase will have to be identified and assessed. Areas that do not further require solutions should be specified. Both short term and long term impacts on sensitive areas if any such as habitat of endangered species of wildlife or plants, sites/monuments of historical and cultural importance, centers with concentrated population in the study area, will be established. Impact of the stack emissions on terrestrial flora will be scientifically documented based upon species composition of the area and their air pollution tolerance levels.

The Consultant in his offer will broadly define the methodologies of impact assessment for the different areas of study. The impact will be expressed through appropriate matrix. Exact methodology will be adopted in consultation with Engineer-in-charge. Special reference should be made with respect to following impacts.

2.4.1.1 Air Quality Impact:

A computer based internationally recognized mathematical air quality model would be identified and run to predict the concentration of SO₂, NO_x & SPM due to the operation

of the power plant. The model should also take into account other sources of pollution and topographical features of the area. The emission of relevant pollutant (SO₂, NO_x and SPM) from nearby sources shall be used in the model for more accurate estimate of air quality. The results will be presented for annual, seasonal and short-term (24 hourly) concentrations over a radius of 25 km. around the plant. The dispersion model results will be included in the report using isopleths or other graphical methods, over laying a land use map of the surrounding area. The predicted air quality has to be compared with existing regulations and mitigative measures, if any, to be identified. The long term and short-term impact at all the monitoring locations shall also be estimated. This shall be done as per latest notification of air quality monitoring by MoEF.

2.4.1.2 Water Quality Impact:

The impact of liquid effluents on natural water bodies receiving the effluents shall be established and significant parameters, which are likely to change critically, are to be clearly spelt out.

2.4.1.3 Impact of Ash Pond Leach ate:

Special studies are to be conducted to understand the possibility of contamination of ground water from the ash pond leach ate. Probable composition of the leach ate is to be determined through lixiviation tests in the laboratory under various possible physico-chemical environment.

A model is to be developed on the basis of lixiviation results, infiltration results and pump test to determine the possibility of ground water contamination. If the possibility of significant ground water contamination is established, suitable techno-economically viable mitigative measures are to be suggested.

2.4.1.4 Impact on Ecology:

Impacts on aquatic species, especially during dry season will be assessed particularly those which are endangered. The parameters, which are of concern, are TSS, TDS, heavy metals, oil and grease, pH and temperature. The assessment will also include impacts of chlorinated organic chemicals. The impact of site preparation activities that may involve site clearing, excavation, earth moving, dewatering or impounding water bodies and developing burrow and fill areas will be assessed. This assessment will give priority to impacts on endangered species, if any. The consultant will recommend measures to mitigate such adverse impacts as soil erosion and habitat loss. In addition, impact of fugitive and stack emissions will be assessed on the surrounding species of economic / genetic / biological importance.

2.4.1.5 Social Impacts:

The consultant will identify and prescribe in the EIA report mitigatory measures associated with the Project's social impacts during its construction and operational phases. Some impacts are associated with the health, sanitation, security and housing needs of the workforce. In particular, the consultant will identify socio-cultural impacts of large number of workers employed during the construction phase on local communities. In addition, the consultant will identify needs for resettlement of people from whom the land is to be acquired for the Project site. A detailed R&R PLAN to be developed in consultation with state govt. and their approval to be obtained.

2.4.1.6 Prediction of Noise Levels:

Sources of noise and its impact on the environment should be clearly brought out. The noise level at varying distances for multi sources will be predicted using suitable model. A comparison of measured noise (Leq) at monitoring locations to that of predicted noise

levels (Leq) should be made and mitigatory measures required, if any, be recommended to conform to regulatory ambient air noise standards.

2.4.2 Disaster Management Plan and Occupational Safety:

A Disaster Management Plan (DMP) for dealing emergency situation arising due to fire, explosion, leakages of hazardous substances, etc. in the plant is to be prepared. The plan should also include storage, handling, transportation etc. for the hazardous and toxic materials to be used in the power station.

Occupational risk involved during construction and operation of the plant should be assessed and necessary safety and protective measures should be spelt out. The DMP should include both onsite and off site plans.

2.4.3 Green Belt Development Plan:

A green belt development plan for the project site and township should be included in the EIA report. Details such as areas to be planted, suitable plant species, plantation technique and necessary infrastructures required for plantation etc. should be clearly mentioned.

2.4.4 Post Study Monitoring Plan:

It is necessary to monitor certain environmental parameters identified as critical or as required by regulatory agencies. Considering the requirements of Regulatory Agencies and identified critical parameters, the consultant will design a post study environmental monitoring program. The consultant will identify all equipment and manpower requirement necessary for the implementation of this program and cost involved.

2.4.5 Environmental Management Plan:

At this stage, it may become apparent that additional environmental management and pollution control measures will be necessary to meet the requirements of the regulatory agencies. The Consultant will, therefore, recommend mitigative measures as and where such measures are warranted. Environmental Management Plans along with cost estimate will be developed to selectively mitigate the adverse impacts of the power project activities. Recommendations should be made concerning establishment of Environment Management Group and training of staff, wherever necessary.

2.5 Stage 'C':

It includes preparation of EIA documents - Rapid EIA Report based on three-month field data and final EIA report based on one-year field data. In addition, executive summary of the report both in English and regional language of the state where the project is proposed to be located, needs to be prepared.

The basic format of the EIA document will be finalized in consultation with EIC. The format of document will be illustrated with tables, figures and colored maps. The report shall be of a high degree professional quality. The report should also include list of EIA preparers (individual/ organization), references, published material used for the study etc.

Over and above the various aspects mentioned above, adequate care should be taken by the Consultant to ensure that final EIA report covers all the areas and fulfills all the requirements as called for in the document of MoEF& CC titled "Environmental Guidelines for Thermal Plants (1987)", the notification of MOEF dated January 27, 1994, on "Environmental Impact Assessment of Development Projects" and the notification of MOEF dated April 10, 1997 as amended time to time and any new notification for getting environment clearance on "Public Hearing".

2.5.1 Deliverables:

The consultant will submit progress report and schedule of the work on monthly basis. Following deliverables are required to be submitted by the Consultant:

- a) 3 copies of Draft executive summary in English and regional language and Draft Interim EIA Report
- b) 25 copies of executive summary in English.
- c) 25 copies of executive summary in Regional Language.
- d) 25 copies of Interim EIA report.
- e) 3 copies of draft final report.
- f) 15 copies of final EIA report.
- g) All raw data and interim / final EIA report would also be submitted to the Client.

3.0.0 Time Schedule

The total work including mobilization of resources and submission of final deliverables for the complete scope of work is required to be completed within Thirty (30) months from the date of issue of the award letter. However, additional consultancy services, if any, may continue even after Thirty months as required by the owner.

Though the total EIA study shall be based on twelve (12) months cycle, the NOC from SPCB shall be obtained within six (6) months including Public hearing based on three (3) months EIA studies.

4.0.0 Video Coverage

The consultant has to provide video film for the site and surroundings as also the laboratory facilities and various monitoring activities of air quality, water quality, noise, soil, and metrological station etc.

ANNEXURE-1

FIELD	PARAMETERS	NO. OF SAMPLING LOCATIONS	FREQUENCY	BRIEF SAMPLING SPECIFICATIONS
Ambient Air Quality	SO ₂ NO _x SPM RPM	4	Twice a week	24 hour samples at each location using High Volume Sampler. Analysis of samples should be as per Gazette notification dated 20/5/96 on AAQ and amended as on date.
Meteorology	Wind speed & direction	As per design	Continuous Automatic average (Averaging time 1 hour)	A permanent meteorological station is to be established at site for monitoring the meteorological parameters.
	Temperature		Continuous at two levels 2m & 10m (one hour average to be worked out)	
	Max. & Minimum Temp. (Wet & Dry bulb Temp.)		Daily (at 8.30 & 17.30 IST)	
	Solar radiation		Continuous one hr average	
	Humidity		Daily 8.30 to 17.30 IST	
	Atmospheric pressure		Daily 8.30 to 17.30 IST	
	Rainfall		Daily	
	Storm		Daily	
Water Quality (surface & ground water samples)	Physical parameters: pH, Temp., DO, Conductivity & TSS	6	Monthly	
	Physical parameters: Total dissolved solids, Alkalinity, Hardness. BOD, COD, NO ₃ , Po ₄ , Cl, So ₄ , Na, K, Ca, Mg, Silica oil & grease, phenolic compounds	6	Monthly	

FIELD	PARAMETERS	NO. OF SAMPLING LOCATIONS	FREQUENCY	BRIEF SAMPLING SPECIFICATIONS
	Bacteriological MPN and Total coliform	6	Monthly	
	Heavy metals (As, Hg, Pb, Cd, Cr-6, total Cr, Cu, Zn, Se, Fe)	6	Quarterly	
Noise	Leq 10	10	Twice in a year	24 hourly sampling location using an integrating sound level meter
Sediments	Metals, Trace metals, pesticides, benthos	5	Twice in year	
Soil	Ph, conductivity, cation exchange capacity: N, P, K etc	10	Twice in a year	
Ecology	Aquatic	Three	Twice in a year	
	Terrestrial	Three	Twice in a year	

SECTION -4
CONTRACT AGREEMENT

CONTRACT FOR CONSULTANCY SERVICES

This CONTRACT (hereinafter, together with all Appendices attached hereto and forming an integral part hereof, called the "Contract") is made this day of the month of _____ 2018, between:

PFC Consulting Limited (a wholly owned subsidiary of Power Finance Corporation Limited, a Government of India Company) incorporated under the Indian Companies Act 1956, having its registered office at first Floor,'Urjanidhi,1-Barakhamba Lane, Connaught Place New-Delhi-110001 hereinafter referred to as "Owner"(which expression shall unless repugnant to the context or the meaning thereof include its successors and permitted assigns)

AND

_____ a Company incorporated under the Indian Companies Act, 1956, having its registered office at _____

_____hereinafter called the "Consultant" (which expression shall unless repugnant to the context or the meaning thereof include its successors and permitted assigns)

WHEREAS the Owner is in the process of providing "**Consultancy Services for Site Feasibility Study, Conducting various Technical Studies & obtaining Environment Clearance for 2x660 MW Thermal Power Project to be set up by Sangam Power Generation Company Limited in the State of Uttar Pradesh.**" (herein after to be referred as Project)

AND WHEREAS the Owner is intending to hire an experienced and qualified Consultant who has undertaken similar projects and is capable of providing consultancy services in conjunction with other specialist consultants, and personnel for providing "Services" and advice in regard to the "Consultancy Service Package" for the Project.

AND WHEREAS the Consultant, have represented to the Owner, that they have the requisite experience, professional skills, adequate manpower and technical resources and personnel, to render the Services required by the Owner in a timely and efficient manner.

AND WHEREAS based on above representations of the Consultant, the Owner has agreed to appoint the Consultant to render services on the terms and conditions hereafter contained:

NOW THEREFORE THIS AGREEMENT WITNESSES THAT, IN CONSIDERATION OF THE PREMISES AND THE MUTUAL COVENANTS HEREIN CONTAINED, IT IS AGREED BETWEEN THE PARTIES AS FOLLOWS:

1.0 GENERAL PROVISIONS

1.1 Definitions

Unless the context otherwise requires, the following terms whenever used in this Contract, Appendices, Schedules and Exhibits shall have the following meanings:

- (a) "Approvals" shall mean all consents, licenses and approval of any local, municipal, State or National Authority necessary to carry out the services for each and every phase of the Project.
- (b) "Contract" means this Contract together with all Appendices, Attachments, Exhibits and Schedules and including all modifications made in accordance with the provisions of Clauses 12 hereof between the Owner and the Consultant.

- (c) "Consultant" means _____ Company and also includes any other consultants or sub-consultants as may be appointed by the Consultant herein with the written approval of the owner, for providing of the services to the Owner in execution of the Project.
- (d) "Confidential Information" means any material, proprietary, non-public information acquired, developed, disclosed or exchanged among the parties pursuant to this Agreement.
- (e) "Effective Date" means the date on which this Contract comes into force and effect pursuant to Clause 3.1 hereof;
- (f) "Personnel" means persons hired by the Consultant or by his Sub -consultant as employees, for the purposes of rendering services or any part thereof; Personnel includes:
- (i) "Local Personnel" mean such persons who at the time of being so hired have their domicile in India and;
 - (ii) "Foreign Personnel" mean such persons who at the time of being so hired had their domicile outside India
- (g) "Parties" means the Owner or the Consultant, as the case may be;
- (h) "Contract time" means the duration of time of the Contract as referred to Clause 3.
- (i) "No claim Certificate" means certificate issued by the Owner after the Contract has expired and the consultant has performed all his Services as per the terms and conditions envisaged in this Contract and all undisputed payments of remuneration and reimbursable expenditures payable by the Owner to the Consultant has been made.
- (j) "Project" means **"Consultancy Services for Site Feasibility Study, Conducting various Technical Studies & obtaining Environment Clearance for 2x660 MW Thermal Power Project to be set up by Sangam Power Generation Company Limited in the State of Uttar Pradesh"**.
- (k) "Services" means the works to be provided/performed by the Consultant and/or, the Sub-Consultants for completion of various tasks as described in Appendix A hereto;
- (l) "Starting Date" means the date referred to in Clause 3.3 hereof;
- (m) "Sub Consultant" means any person/entity to whom the Consultant subcontracts for any part of the Services in accordance with the provisions of Clause 5.5 hereinafter; and
- (n) "Third Party" means any person or entity other than the Owner, the Consultant or his Sub-consultant.

2.0 LOCATION FOR PERFORMANCE OF THE SERVICES:

- (a) The Consultant shall render/perform services at Delhi and at the Project site in Allahabad district, Uttar Pradesh.
- (b) The Consultant also undertakes to perform/render services at other location or elsewhere as required for the execution of project or as specified by the Owner from time to time. The Owner shall not bear any extra expenses/cost if, any, incurred by the consultant for providing services at other location.

3.0 COMMENCEMENT, COMPLETION, AND TERMINATION OF CONTRACT

3.1 Commencement of Contract

This contract shall come into force from the date ("effective date") on which the Owner and the Consultant have signed the present contract.

3.2 Termination of Contract for Failure to Become Effective

- a) If this Contract has not become effective within 15 days from effective date the Owner has the right to declare the same to be null and void, and in the event of such a declaration the consultant shall not have any claim against the Owner.
- b) In case the contract is rendered null and void on account of failure/inaction on the part of the consultant, the consultant shall be liable to pay damages to the Owner.

3.3 Commencement of Services

The Consultants shall begin carrying out the Services immediately viz. from the date of issue of Letter of Award (the "Starting Date"), or on such date as the Parties may agree in writing

3.4 Expiration of Contract

Unless terminated earlier pursuant to Clause 10 hereof, this Contract shall expire after the consultant has performed all his Services as per the terms and conditions envisaged in this Contract and the Owner has issued a 'No claim Certificate' to the Consultant.

The Owner shall issue the "No claim certificate" after being satisfied that the Consultant has performed/rendered all the services to the satisfaction of the Owner, as per the contract and all undisputed payments of remuneration and reimbursable expenditures payable by the Owner to the Consultant has been made.

4.0 Contract Performance Guarantee

- 4.1 The Consultant within 30 days from the date of issue of Letter of Award shall furnish a Performance Guarantee in the form of Bank Guarantee as per Performa attached as Section-2 of bid document, from any Bank towards performance of the Contract. The guarantee amount shall be equal to ten percent (10%) of the contract price in accordance with the terms and conditions specified in the contract and in the Bid Documents. The guarantee shall be valid until after expiry of a period of 6 months from the date of issue of No Claim Certificate by the Owner.

4.2 The Contract Performance Guarantee is intended to secure the performance of the entire contract and shall not be construed as limiting the damages stipulated in other clauses in the Bid Documents.

4.3 The Performance Guarantee will be returned to the Contractor without any interest at the end of the Guarantee Period.

5.0 OBLIGATIONS OF THE CONSULTANTS

5.1 Standard of performance

The Consultant shall perform the Services and carry out his obligations hereunder with all due diligence, efficiency and economy, in accordance with generally accepted techniques and practices used with professional engineering and consulting standards recognized by professional bodies, and shall observe sound management, and technical and engineering practices, and employ appropriate advanced technology and safe and effective equipment, machinery, materials and methods in execution of project. The Consultant shall always act, in respect of any matter relating to this Contract or to the Services, as faithful advisers to the Owner, and shall at all times support and safeguard the Owner's legitimate interests in any dealings with Consultants/Sub-consultants or Third Parties.

5.2 COMPLIANCE WITH RULES AND REGULATIONS

The Consultant agrees that it shall be responsible and liable to comply with and also undertakes to ensure and be responsible for compliance by the Sub consultants, agents of the Consultants and Sub-consultants and Personnel, with all the rules and regulations of various concerned government authorities and departments for the services rendered under this agreement.

5.3 CONFLICT OF INTEREST

The consultant shall hold the Owner's interest paramount, without any consideration for future work, and strictly avoid conflict with other assignments or their corporate interests.

5.4 Benefit from Commissions, Discounts etc.

Payment to the Consultant shall constitute the Consultant's only payment in connection with this Contract or the Services, and the Consultant shall not accept for their own benefit any trade commission, discount, or similar payment in connection with activities pursuant to this Contract or to the Services or in the discharge of their obligations under the Contract, and the Consultant shall use their best efforts to ensure that the Personnel, any Sub-Consultants, and agents of either of them similarly shall not receive any such additional benefits.

5.5 Consultants and Affiliates not to be otherwise interested in Project

The Consultant agrees that, during the term of this Contract, the Consultant, Sub Consultant, Personnel and/or any entity affiliated with the Consultant or Sub-Consultant shall not provide services resulting from or directly related to the Consultant's Services for the preparation or implementation of the project to any third party. In the event of breach of the aforesaid condition the Owner shall be entitled to disqualify such Consultant or the Sub Consultant or any of their Personnel from providing services to the Owner and further claim damages for breach.

5.6 Prohibition of Conflicting Activities

The Consultant shall not engage, and shall cause their Personnel as well as their Sub-Consultants and their Personnel not to engage, either directly or indirectly, in any business or professional activities which would conflict with the activities assigned to them under this Contract.

5.7 Insurance to be taken out by the Consultant

The Consultant shall take out and maintain, and shall cause its Sub-Consultants to take out and maintain, at their own cost, insurance against risks etc.

5.8 Liability of the Consultants

The Consultant and each of his Members (consultant personnel, sub-consultant, sub-consultant personnel) shall be jointly and severally liable to the Owner for the performance of the Services under this Contract and further for any loss suffered by the Owner as a result of a default of the Consultant or his members in such performance, subject to the following limitations:

- (a) The Consultant shall not be liable for any damage or injury caused by or arising out of the act, neglect, default or omission of any persons other than the Consultants, its Sub-consultants or the Personnel of either of them; and
- (b) The Consultant shall not be liable for any loss or damage caused by or arising out of circumstances of Force Majeure.

5.9 Consultant Action Requiring Owner's Prior Approval

The Consultant shall obtain the Owner's prior approval in writing before taking any of the following actions:

- (a) appointing personnel to carry out any part of the Services, including the terms and conditions of such appointment ;
- (b) entering into a subcontract with the Sub consultant for the performance of any part of the Services, it being understood:
 - (i) That the selection of the Sub-consultant and the terms and conditions of the subcontract shall have been approved in writing by the Owner prior to the execution of the subcontract, and
 - (ii) That the Consultants shall remain fully liable for the performance of the Services by the Sub-consultant and its Personnel pursuant to this Contract;

5.10 Reporting Obligations

The Consultant shall submit to the Owner the reports and documents specified in Appendix B hereto, in the form, in the numbers and within the time periods set forth in the said Appendix, including any supporting data required by the Owner.

5.11 Documents Prepared by the Consultants to Be the Property of the Owner

All plans, drawings, specifications, designs, reports and other documents prepared by the Consultants in performing the Services shall become and remain the property of the Owner, and the Consultant shall, not later than upon termination or expiration of this Contract, deliver all such documents to the Owner, together with a detailed inventory thereof.

6.0 CONSULTANTS' PERSONNEL

6.1 Agreed Personnel

The Consultant hereby agrees to engage the personnel and sub-consultants listed by title as well as by name in **Appendix C** in order to fulfill his contractual obligations under this contract.

6.2 General

The Consultants shall employ and provide such qualified and experienced Personnel as are required to carry out the Services.

6.3 Description of Personnel

- (a) The titles, job descriptions, minimum qualifications and estimated period of engagement in the carrying out of the Services of each of the Consultants' Personnel are described in **Appendix C**.
- (b) If required to comply with the provisions of **Clause 5.4** of this Contract, adjustments with respect to the estimated periods of engagement of Personnel set forth in **Appendix C** may be made by the Consultant by written notice to the Owner, provided:
 - (i) that such adjustments shall not alter the originally estimated period of engagement of any individual by more than 10% or one week, whichever is larger.
 - (ii) that the aggregate of such adjustments shall not cause payments under this Contract to exceed the ceilings set forth in **Clause 8** of this Contract. Any other such adjustments shall only be made with the Owner's written approval.
- (c) If additional work is required beyond the scope of the Services specified in **Appendix A**, the estimated periods of engagement of Personnel set forth in **Appendix C** may be increased by agreement in writing between the Owner and the Consultants, provided that any such increase shall not, except as otherwise agreed, cause payments under this Contract to exceed the ceilings set forth in **Clause 8** of this Contract.

6.4 Removals and/or Replacement of Personnel

- a) Except as the Owner may otherwise agree, no changes shall be made in the Personnel. If, for any reason beyond the reasonable control of the Consultants, it becomes necessary to replace any of the Personnel, the Consultants shall forthwith provide as a replacement a person of equivalent or better qualifications.

- (b) If the Owner:
- i) finds that any of the Personnel has committed serious misconduct or has been charged with having committed a criminal action, or
 - (ii) has reasonable cause to be dissatisfied with the performance of any of the Personnel,

then the Consultants shall, at the Owner's written request specifying the grounds therefore, forthwith provide as a replacement a person with qualifications and experience acceptable to the Owner.

- (c) The new personnel provided as a replacement shall be governed by the same the terms and conditions of employment as the replaced personnel.
- (d) The Consultants shall bear all additional travel and other costs arising out of or incidental to any removal and/or replacement.

7.0 OBLIGATIONS OF THE OWNER

Payment

In consideration of the Services performed by the Consultants under this Contract, the Owner shall make to the Consultants such payments and in such manner as is provided by **Clause 8** of this Contract.

8.0 PAYMENTS TO THE CONSULTANTS

8.1 The Lump-sum cost of services payable in Indian Rupees is set forth in **Appendix E**.

8.2 Mode of Payment

Payments will be made by the Owner to the consultant as follows:

(In accordance with the terms of payment to be enumerated in LoA)

Any deviation to the above payment terms is not permitted.

8.3 The Consultant shall submit the bills in triplicate to the Owner on printed bill forms indicating the work done by him during the period for which payment is sought.

8.4 The Owner shall cause the payment of the Consultant as per the above given schedule of payment within sixty (60) days of the receipt of the bills raised along with supporting documents. However, it is agreed between the parties that the Owner may restrict or withhold the payment if the performance or progress of the services rendered by the Consultant or his members (sub consultants) is not satisfactory and not in accordance with the work program/schedule.

8.5 The final payment under this Clause shall be made only after satisfactory completion of the activities mentioned in the Terms of Reference (**Appendix-A** and **Appendix-B**) and after the issuance of No Claim Certificate.

8.6 All payments under this Contract shall be made to the account of the Consultants with:

Account No _____ Bank,

9.0 Suspension

The Owner may, by written notice of suspension to the Consultants, suspend all payments to the Consultant and invoke Performance Bank Guarantee hereunder:

- (k) if the Consultant fails to perform any of its obligations under this Contract, including carrying out of the Services, provided, that such notice of suspension (i) shall specify the nature of the failure, and (ii) shall request the Consultants to remedy such failure within a period not exceeding thirty (30) days after receipt by the Consultant of such notice of suspension
- or**
- (ii) if at any stage it is found that the Consultant has provided any wrong information/ false information/ mis-represented the fact.

10.0 Termination

10.1 By the Owner

The Owner may terminate this contract, by issuing a written notice not less than thirty (30) days, from the date of occurrence of any of the events as specified in sub clause (a) to (e) of this Clause.

The Owner may terminate this contract, by issuing a written notice not less than sixty (60) days, from the date of occurrence of the event as specified in sub clause (f) of this Clause.

- (a) if the Consultants fail to remedy a failure in the performance of their obligations hereunder, as specified in a notice of suspension pursuant to Clause 9 hereinabove, within thirty (30) days of receipt of such notice of suspension or within such further period as the Owner may have subsequently approved in writing;
- (b) if the Consultant fail to comply with any final decision reached as a result of arbitration proceedings pursuant to **Clause 19** hereof;
- (c) if the Consultant submit to the Owner a statement which has a material effect on the rights, obligations or interests of the Owner and which the Consultants know to be false;
- (d) if, as the result of Force Majeure, the Consultants are unable to perform a material portion of the Services for a period of not less than sixty (60) days; or
- (e) if Consultant become Bankrupt and the company has been wound up through liquidation proceedings.
- (f) if the Owner, in its sole discretion and for any reason whatsoever, decides to terminate this Contract.

10.2 Cessation of Rights and Obligations

Upon termination of this Contract pursuant to Clauses 10 hereof, or upon expiration of this Contract pursuant to Clause 3 hereof, all rights and obligations of the Parties hereunder shall cease, except

- (a) such rights and obligations as may have accrued on the date of termination or expiration,
- (b) the obligation of confidentiality set forth in Clause 16 hereof,
- (c) any right which a Party may have under the Applicable Law.

10.3 Cessation of Services

Upon termination of this Contract by notice to pursuant to Clauses 10 hereof, the Consultants shall, immediately upon dispatch or receipt of such notice, take all necessary steps to bring the Services to a close in a prompt and orderly manner and shall make every reasonable effort to keep expenditures for this purpose to a minimum.

10.4 Payment upon Termination

Upon termination of this Contract pursuant to **Clause-10** hereof, the Owner shall make the following payments to the Consultant:

- (a) remuneration pursuant to **Clause 8** hereof for Services satisfactorily performed prior to the effective date of termination;
- (b) reimbursable expenditures pursuant to Clause 8 hereof for expenditures actually incurred prior to the effective date of termination; and
- (c) except in the case of termination pursuant to paragraphs (a) to (b) of **Clause 10.1** hereof, reimbursement of any reasonable cost incident to the prompt and orderly termination of the Contract including the cost of the return travel of the Consultants' personnel.
- (d) If due to any reason or decision of the Govt/Client. the Assignment is dropped and the Consultant is directed to discontinue work, the "Drop Dead Fee" would be limited to the payments received by the Consultant and the claims already raised, as per the payment terms relating to the Assignment, till the point of calling off the Assignment or as mutually agreed.

11.0 Force Majeure

11.1 Definition

- (a) For the purposes of this Contract, "Force Majeure" means an event or circumstance or combination of events and circumstances, the occurrence of which is beyond the reasonable control of either party and which materially affects the performance by either Party of its obligations under this agreement, provided such material and adverse effect could not have been prevented, overcome or remedied in whole or in part by the affected party and includes, but is not limited to, war, riots, civil disorder, earthquake, fire, explosion, storm, flood or other adverse weather conditions, strikes, lockouts or other industrial action (except where such strikes, lockouts or other industrial action

are within the power of the Party invoking Force Majeure to prevent), confiscation or any other action by government agencies.

- (b) It is however agreed that 'Force Majeure' shall not mean or include:
 - (1) any event caused by the negligence or intentional action of a Party or such Party's Sub-consultants or agents or employees, nor
 - (2) any event which a diligent Party could reasonably have been expected take into account at the time of the execution of this Agreement, and avoid or overcome in the carrying out of its obligations hereunder.
- (c) The Consultant shall not be paid /reimbursed any further price or cost or any additional cost in re-activating the services after the end of Force Majeure event.

11.2 No Breach of Contract

Neither party shall be responsible or be liable for, or deemed to be in breach hereof because of any failure or delay in complying with its obligations under or pursuant to this Agreement due to one or more events of Force Majeure or its effects or any combination thereof, provided that the Party affected by such an event has taken all reasonable precautions, due care and reasonable alternative measures, all with the objective of carrying out the terms and conditions of this Contract. However it is agreed that in no event shall Force Majeure shall exclude any Party's obligation to pay monies under this Agreement.

11.3 Measures to be taken

- (a) A Party affected by an event of Force Majeure or any combination of events shall take all reasonable measures to remove such Party's inability to fulfill its obligations hereunder with a minimum of delay.
- (b) A Party affected by an event or any combination of events of Force Majeure shall notify the other Party of such event as soon as possible, and in any event not later than fourteen (14) days following the occurrence of such event, providing evidence of the nature and cause of such event, and shall similarly give notice of the restoration of normal conditions as soon as possible.
- (c) The Parties shall take all reasonable measures to minimise the consequences of any event of Force Majeure.

11.4 Extension of Time

Any period within which a Party shall, pursuant to this Contract, complete any action or task, shall be extended for a period equal to the time during which such Party was unable to perform such action as a result of Force Majeure.

11.5 Consultation

Not later than thirty (30) days after the Consultant, as the result of an event of Force Majeure, have become unable to perform a material portion of the Services, the Parties

shall consult with each other with a view to agreeing on appropriate measures to be taken in the circumstances.

12.0 Amendment/Modification

This Agreement may not be altered, modified, revoked or cancelled in any way unless such alteration, modification or cancellation is in writing and duly signed by or on behalf of the parties which shall not be effective until the consent of the parties has been obtained. However, it is agreed between the parties that each Party shall give due consideration to any proposals for modification made by the other Party.

13.0 Amicable Settlement

The Parties shall use their best efforts to settle amicably all disputes arising out of or in connection with this Contract or the interpretation thereof. Any dispute between the parties as to matters arising pursuant to this Contract which cannot be settled amicably shall be resolved as per the Indian Arbitration Act, 1996 as amended from time to time.

14.0 FAIRNESS AND GOOD FAITH

14.1 Good Faith

The Parties hereunder undertake to act in good faith with respect to their performance, obligations and rights under this Agreement and further undertake, during the tenure of this Agreement, to take all reasonable measures, to ensure the achievement/realization of the objectives of this Agreement.

14.2 Operation of the Contract

The Parties recognize that it is impractical in this Contract to provide for every contingency which may arise during the life of the Contract, and the Parties hereby agree that it is their intention that this Contract shall operate fairly as between them, and without detriment to the interest of either of them, and that, if during the term of this Contract either Party believes that this Contract is operating unfairly, the Parties will use their best efforts to agree on such action as may be necessary to remove the cause or causes of such unfairness, but on failure to agree on any action pursuant to this clause shall give rise to a dispute subject to arbitration in accordance with clause 18 hereof.

15.0 TAXES AND DUTIES/CHANGE IN LAW.

It is hereby agreed between the parties that the Consultant and its personnel shall pay the taxes, duties, fees, levies and other impositions levied under the existing, amended or enacted laws during life of this contract and the Owner shall deduct the taxes, duties and levy whatsoever as may be lawfully imposed.

16.0 Confidentiality

The Consultant, their Sub-consultants and the Personnel of either of them shall not, either during the term or within two (2) years after the expiration of this Contract, disclose any proprietary or Confidential Information relating to the Project, Services, under this Contract or any information pertaining to the Owner's business or operations without the prior written consent of the Owner.

17.0 Law Governing Contract

This Agreement, its meaning and interpretation, and the relation between the Parties shall be governed by Indian Laws or any statutory modifications thereof, and shall be subject to the exclusive jurisdiction of the Courts of **Delhi** in any matter arising under this Agreement and or in matters pertaining to the conduct of arbitration, enforcement of the award or obtaining of interim relief(s) etc.

18.0 SETTLEMENTS OF DISPUTES/ ARBITRATION.

18.1 The parties shall endeavor to resolve amicably, in the first instance, all disputes, controversies or differences which may arise between the Parties, out of or in relation to or in connection with this Agreement, or for breach thereof.

18.2 In the event, the parties are unable to resolve such dispute/difference amicably within **ninety (90)** days after the same has arisen then the dispute shall be referred to arbitration in accordance with the Rules of Arbitration of the Indian Council of Arbitration and such arbitration shall be conducted in accordance with the rules of ICA. The place of arbitration shall be New Delhi or any other place mutually agreeable by the parties and the language of arbitration shall be English

The Arbitration shall be conducted by panel of 3 Arbitrators, one to be appointed by each party and third Arbitrator to be appointed by two Arbitrators as the Chairman of the Tribunal.

The Parties agree that the arbitrator's decision shall be final and conclusive. The costs of arbitration (including without limitation, those incurred in the appointment of the arbitrators) shall be borne equally by the Parties hereto; however each Party shall pay its respective legal charges. The Award shall be final and binding and non-appeal able. Judgment on the award may be entered and enforced in any court of competent jurisdiction. By execution and delivery of this Agreement, each Party agrees and consents to the jurisdiction of the aforesaid arbitration panel and solely for the purpose of enforcement of an arbitral award, as referred to hereinabove, in any court of competent jurisdiction for itself and in respect of its property and waives in respect of both itself and its property, any defense it may have to or based on sovereign immunity, jurisdiction, improper venue or inconvenient forum.

19.0 GENERAL PROVISIONS

19.1 Language

This Contract has been executed in the English language, which shall be the binding and controlling language for all matters relating to the meaning or interpretation of this Contract.

19.2 Headings

The headings shall not limit, alter or affect the meaning of this Contract.

19.3 Notices

Any notice, request or consent required or permitted to be given or made pursuant to this Contract shall be in writing. Any such notice, request or consent shall be deemed to have been given or made when delivered in person to an authorized representative of the Party to whom the communication is addressed, or when sent by registered mail, or facsimile to such Party at the following address:

1. For the Owner: **PFC Consulting Limited.**
(A Wholly Owned Subsidiary of Power Finance Corp. Ltd.)
First Floor,'Urjanidhi', 1, Barakhamba Lane,
New Delhi - 110001

Facsimile: Attention: 011-23456170, Mr. _____

2. For Consultants:

Attention: _____
Facsimile: _____ **Email :** _____

19.4 Notice will be deemed to be effective as follows:

- (a) in the case of personal delivery or registered mail, on delivery;
- (b) in the case of facsimiles, forty eight (48) hours following confirmed transmission.

19.5 A Party may change its address for notice hereunder by giving the other Party notice of such change pursuant to this Clause.

19.6 Authority of Consultant in Charge

The Consultant hereby authorize : Mr./Ms. _____ to act on their behalf in exercising all the Consultants' rights and obligations towards the Owner under this Contract, including without limitation the receiving of instructions and payments from the Owner.

19.7 Authorised Representatives

Any action required or permitted to be taken, and any document required or permitted to be executed under this Contract, may be taken or executed:

- (a) on behalf of the Owner by _____ or his designated representative;

(b) on behalf of the Consultants _____ or his designated representative.

19.8 WAIVER OF RIGHT.

The failure of either party to enforce at any time or for any period of time, the provisions hereof shall not be construed to be waiver of any provision or of any right and shall not preclude such party from subsequently enforcing such provisions or right.

19.9 SEVEREABILITY CLAUSE

If any provision of this Agreement shall be determined to be void or unenforceable, such provision shall be amended or deleted in so far as is reasonably consistent with the provisions of this Agreement and to the extent necessary to conform to applicable law and the remaining provision of this Agreement shall remain valid and enforceable in accordance with their terms.

19.10 This Agreement may be executed in any number of counterparts which together shall constitute a single agreement.

IN WITNESS WHEREOF, the Parties hereto have caused this Contract to be signed in their respective names as of the day and year first above written.

FOR AND ON BEHALF OF
[OWNER]

By:
Authorized Representative

FOR AND ON BEHALF OF
[CONSULTANTS]

By :
Authorized Representative

LIST OF APPENDICES

Duties of the Consultants

Description of the Services

- A - Detailed descriptions of the Services to be provided as per scope of works and deliverables indicated in Bid invitation Letter of Bid Document, letter of the bidding ; dates for completion of various tasks; place of performance for different tasks; specific tasks to be approved by Owner; etc.

Reporting requirements

- B - Format, frequency and contents of reports; persons to receive them; dates of submission; etc.

Consultants' Personnel

- C - Titles and names, [if already available], detailed job descriptions and minimum qualifications of Personnel to be assigned to work in India, and man-months for each.

Duties of the Owner

- D - Services, facilities and property to be made available to the Consultants by the Owner.

Cost of services

- E - Cost of services

Letter of Award

DESCRIPTION OF THE SERVICES

The consultant has to provide services as detailed below as per scope of works and deliverables indicated in Bid invitation Letter of Bid Document, letter of the bidding ; dates for completion of various tasks; place of performance for different tasks; specific tasks to be approved by Owner; etc. which is required for the successful completion of the assignment

Authorized /designated
Representative of Owner

Authorized /designated
Representative of Consultant

REPORTING REQUIREMENTS

1. The Deliverables, Time Schedule and the Completion period will be as indicated below or as agreed from time to time::

Authorized /designated
Representative of Owner

Authorized /designated
Representative of Consultant

CONSULTANTS' SUBCONSULTANTS AND KEY PERSONNEL

C-1 List of key Personnel to be assigned to the assignment

Authorized /designated
Representative Of Owner

Authorized /designated
Representative of Consultant

DUTIES OF THE OWNER

Owner will provide all assistance to the consultant in facilitating the studies and surveys to be conducted at site. This will include but not limited to the following

Authorized /designated
Representative Of Owner

Authorized /designated
Representative of Consultant

