

DABHOL- BANGALORE PIPELINE PROJECT (PHASE- I)

SPECIFIC REQUIREMENTS AND SCOPE FOR GEOTECHNICAL INVESTIGATIONS & HYDROLOGICAL DATA COLLECTION (PART A- MAHARASHTRA & GOA)

B	11.03.10	Revised as per drawing no A027-010-16-71-3001 (Rev.0)	VSP	B.Mandal	S.Debnath
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Rev. No	Date	Purpose	Prepared by	Checked by	Approved by

1.0 GENERAL

M/s. GAIL proposes to install a cross country pipeline from Dabhol to Bangalore. Total length of the pipeline route is about 746.40KM (Ch. -2.650 km to ch.743.749km). Beside this there are two spur lines i.e. at approx. Ch.246.456km (Gokak to Goa having length about 175.328km) and at approx.Ch.731.703 km (Bechenahalli to Bangalore having length about 73.600km).

This specification covers the requirement of Geotechnical Investigation and Hydrological data collection for the Rivers, SV/IP Stations, Dispatch/Receiving terminals, rail / road crossings (if any) etc. for the proposed **Dabhol- Bangalore main pipeline and the spur lines In Maharashtra & Goa States(part-A)**

Bidder has to collect hydrological data for the rivers crossing the pipeline route from authentic source such as CWC, State PWD, Irrigation, Maritime board etc.. The report shall be submitted to OWNER/EIL for review and approval.

Bidder shall acquaint himself with the site condition before quoting and no claim what so ever on cost and time shall be entertained by the owner on this account.

2.0 SCOPE OF WORK FOR GEOTECHNICAL INVESTIGATION:

2.1 This specifications cover the requirement of geotechnical investigation for the main pipeline as well as the one spur-line.

2.2 Boring

(i) Boring into the all type of soil/rock shall be done as below:

River Crossings along main pipeline:

Sl.NO	Name of river / approx width (m)	Boring on bank & River bed Where water depth ≤ 0.5 m	Boring on River bed Where water depth >0.5 m	Remarks (Approx. Chainage in km)
1	Kasari (41m)	2nos-20m deep	1no -20m deep	Ch.25.127
2	Kapsi (79m)	2nos-20m deep	2nos-20m deep	Ch.36.086
3	Kapsi(119m)	2nos-20m deep	3nos-20m deep	Ch36.367
4	Kapsi(106m)	2nos-20m deep	3nos-20m deep	Ch.41.422
5	Veer (100m)	2nos-20m deep	3nos-20m deep	Ch.46.984
6	Gad(183m)	2nos-20m deep	4nos-20m deep	Ch.48.600
7	Shashtri (101m)	2nos-20m deep	3nos-20m deep	Ch.63.311
8	Bav (103m)	2nos-20m deep	3nos-20m deep	Ch.87.594
9	Kadvi (52m)	2nos-20m deep	1no -20m deep	Ch.108.082

Sl.NO	Name of river / approx width (m)	Boring on bank & River bed Where water depth ≤ 0.5 m	Boring on River bed Where water depth >0.5 m	Remarks (Approx. Chainage in km)
10	Kadvi(22m)	2nos-20m deep	1no-20m deep	Ch.112.638
11	Kadvi(23m)	2nos-20m deep	1no-20m deep	Ch.112.753
12	Kadvi(53m)	2nos-20m deep	1nos-20m deep	Ch.138.476
13	Panchganga (98m)	2nos-20m deep	3nos-20m deep	Ch.182.031

SV/IP/ Stations & Despatch/Receiving Terminals along main pipeline

Sl. No	Location	Approx. Chainage (km)	Boreholes/ Depth	Remarks
1	DT-(Dabhol)	CH.-2.650	2nos. - 15m deep	Locations shall be provided at award of job
2	SV-1 (Pangari)	CH.18.743	1nos.-15m deep	At the centre of plot
3	SV-2 (Kajurli)	CH.42.000	1nos.-15m deep	-Do-
4	SV-3 (DingniKuran)	CH.60.463	1nos.-15m deep	-Do-
5	IPS-1(Patgaon)	CH. 80.078	2nos. - 15m deep	Locations shall be provided at award of job
6	SV-4(Murshi)	CH.97.900	1nos.-15m deep	At the centre of plot
7	SV-5(Shirgaon)	CH.124.887	1nos.-15m deep	-Do-
8	SV-6(Kodoli)	CH.150.235	1nos.-15m deep	-Do-
9	IPS-2 (Herle)	CH. 173.196	2nos. - 15m deep	Locations shall be provided at award of job

Note: 1) All Chainage indicated above are in KM and are W.r.t Chainage -2.650 At Dabhol Despatch Terminal (**Refer Drawing No. A027-010-16-71-3001 Rev. 0**)

2) The boreholes at river crossings are to be located at a distance of 10M on either Side of the proposed pipeline alignment

River Crossings along 24th Spur PipeLine from Gokak To Goa (At Chainage 246.456km):

Sl.NO	Name of river / approx width (m)	Boring on bank & River bed Where water depth ≤ 0.5 m	Boring on River bed Where water depth >0.5 m	Remarks (Approx. Chainage in km)
1	Valvot (69M)	2nos-20m deep	2nos-20m deep	Ch.145.207
2	Kundne (30M)	2nos-20m deep	1no-20m deep	Ch.148.361
3	Mandavi (475M)	4nos-20m deep	4nos-20m deep	Ch.150.517
4	Zuari (609M)	4nos-20m deep	4nos-20m deep	Ch.165.695

SV/IP Stations & Despatch/Receiving Terminals along 24th Spur PipeLine from Gokak To Goa (At Chainage 246.456km)

Sl. No	Location	Approx. Chainage (KM)	Boreholes/ Depth	Remarks
1	IP-1G(Dhumrewadi)	CH.84.100	2nos. - 15m deep	Locations shall be provided at award of job
2	SV-3G(Hevale)	CH.113.500	1nos.-15m deep	-Do-
3	SV-4G(Kudchire)	CH.141.700	1nos.-15m deep	-Do-
4	SV-5G	CH.163.500.	1nos.-15m deep	-Do-
5	RT- (Goa)	CH.175.328 of spur line	2nos -15m deep	Locations shall be provided at award of job

Note: 1) All Chainage Indicated above (**For Spur Line**) are in KM and are W.r.t Chainage 0.00 At DT/IPS-3 located at chainage 246.456 of main Pipeline (**Refer Drawing No A027-010-16-71-3001 Rev. 0**)

2) The boreholes at river crossings are to be located at a distance of 10M on either Side of the proposed pipeline alignment

Crossing of Rail /Major Roads:

Actual nos of such crossings could not ascertain now. However for each crossing 2 bore holes to be Carried Out upto 10.0m depth below lowest ground

(ii) Trial Pits – 14 Nos (One at each SV,IP,DT&RT Locations, excluding river crossings)

(iii)Electrical resistivity Test - 19 Nos (One at each SV Stations & 2 Nos at each IP RT & DT Locations, excluding river crossings)

2.3. The minimum work shall comprise of as mentioned above in clause 2.2 but not be limited to the following:

2.3.1 Equipment

Contractor shall mobilize necessary no of rigs, equipments, tools & tackles etc. for carrying out the field investigation works specified above within the stipulated time period.

2.3.2 Boring in the riverbed must be carried out with the help of a **Boat/Pontoon/raft** including staging etc.specially designed for this purpose. The boring plant (included Tripod Stand, Rig & Mud circulation Pump etc.) Should be erected on the Boat/Pontoon/raft with sufficient numbers of anchoring, so that the lateral movement of the Boat/Pontoon/raft will be completely arrested. The Vertical Movements or oscillation of the Boat/Pontoon/raft should be arrested by suitable provisions with due tolerance for current of flow/waves etc .The Vertical alignment of the borehole should be ensured by fixing Casing guard at the centre of the Boat/Pontoon/raft (from Boat/Pontoon/raft floor level to a sufficiently Hard stratum in the sub soil) to withstand the movement of the Boat/Pontoon/raft as well as Protect the sides of bore holes

2.3.2.1 Marking of test locations at site and taking R.L of test locations.

2.3.2.2 Conducting Standard penetration tests and collecting disturbed and undisturbed Soil samples from boreholes.

2.3.2.3 Collection of soil and ground water samples for chemical testing.

2.3.2.4 Recording water table in the boreholes.

2.3.2.5 Collection of bulk soil samples from receiving / dispatch terminals or any other location as per instruction of Engineer-in-charge for laboratory CBR test.

2.3.2.6 Carrying out laboratory tests on soil/water samples collected from boreholes.

2.3.2.7 Preparation and submission of report in six hard copies and soft copies in CD ROM (2nos)

3.0 SCOPE OF WORK FOR HYDROLOGICAL DATA COLLECTION:

3.1 To collect and furnish authentic hydrological data available from the regulatory agencies for each of the river crossings. The data shall include but not limited to the following:

i) High Flood Level (HFL)

ii) Discharge at HFL

- iii) Velocity of flow at HFL
- iv) Other river details such as meandering etc
- v) Calculation of Scour Depth & Furnishing Scour Profile
- vi) Existence of any bridge or barrage or any other hydraulic structures within ten kilometers (10KM) upstream and down stream of the crossings for each river crossings site from the local/regional agencies such as CWC, Department of Irrigation, Flood Control Authority, PWD etc. The data shall be maximum of the recorded data in the last 15 to 25 years

3.2 Preparation and submission of report in six hard copies and soft copies in CD ROM (2nos)

4.0 MANDATORY REQUIREMENTS:

- 4.1 Field Work: The contractor shall have to mobilize an experienced Geotechnical Engineer having minimum 5 (five) years experience for supervision of field works during the entire period of field investigation. Field work shall not be permitted without the Geotechnical Engineer at site.
- 4.2 Other Work: The contractor shall have to engage a qualified Geotechnical Engineer (must have master degree in Soil Mechanics & Foundation Engineering) of minimum 3 (three) years experience for preparation of the investigation report and the Engineer should visit site to familiarize with the site conditions and to assess various field and laboratory tests to arrive at design parameters.
- 4.3 All test equipments and tools shall have to confirm the relevant IS code of practice.
- 4.4 The contractor shall confirm their schedule of field/ lab investigations well in advance for the purpose of witness of tests by OWNER/EIL

5.0 FIELD WORK:

5.1 BORING

Boring shall be carried out in accordance with the provision of IS: 1892. **Minimum diameter of boring shall be 150mm.** Auger boring shall be resorted to above the water table, whereas below the water table the boreholes shall be advanced by rotary drilling with mud circulation through all kinds of soil other than rock. While boring above water table, no water shall be introduced in the boreholes. Casing shall be used to support the sides of boreholes in soft to firm soils.

Use of chisel, percussion, and drilling with NX size may be permitted exclusively in strata having SPT-N greater than 100 blows per 30cm penetration and as per direction of Engineer-in-charge.

Coring shall be done with NX size diamond drill bit. Double tube core barrel shall be used for coring.

The depth of ground water table shall be measured. The water table in the borehole shall be allowed to stabilize after depressing the water level adequately by bailing.

5.1.1 Termination Criteria of boreholes:

- i) *Termination criteria of boreholes for SV/IP, Receiving & Despatch Terminals, Road/Rail Crossings, all rivers crossings where HDD is not envisaged:*
 - a) Maximum depth as specified
 - b) After observing five SPT N value more than 100 at an interval of 1.50m.
 - c) After coring 3m in soft / weathered rock (core recovery up to 50%) or after coring 1m in hard rock (core recovery greater than 50%).
- ii) *Termination criteria of boreholes in river bed for river crossings where HDD is envisaged (as indicated in Table-1 & 2 below):*
 - a) Up to maximum depth as Specified (however boreholes located at river bank shall be terminated as per criteria specified in Clause .5.1.1 (i))

Table-1

S.No.	Name of River	Approx Chainage (in KM)	Remarks
1	Kapsi	CH.36.367	DABHOL- BIDADI SECTION
2	Kapsi	CH.41.422	
3	Veer	CH.46.984	
4	Gad	CH.48.600	
5	Kadvi	CH.138.449	
6	Panchganga	CH.182.031	

Table-2

S.No.	Name of River	Approx Chainage (in KM)	Remarks
1	Mandavi	CH 150.517	GOKAK- GOA SECTION (on 24" Spur line route)
2	Zuari	CH 165.695	

5.2 STANDARD PENETRATION TESTS (SPT)

These shall be conducted in boreholes at interval of 1.5m or at change of strata starting first test at 0.5m depth. Last SPT shall be conducted at the termination depth of borehole. The disturbed representative samples shall be visually classified, labeled for identification, and properly preserved for laboratory testing. SPT shall be terminated at any depth when the number of blows exceeds 100 for a

penetration of 30cm or less. All test equipments and tools shall confirm to relevant IS code of practice

5.3 UNDISTURBED SAMPLES

Undisturbed samples of 100mm dia shall be taken from all boreholes and from representative strata at intervals of 3.0m or change of strata whichever occurs earlier starting first UDS at 2.5m depth. For stiff clays, area ratio of the sampling tubes shall not exceed 20%. In soft deposits piston sampler shall be used to collect UDS. Quoted rates shall include transport of samples to the laboratory.

Care shall be taken to minimize sample disturbance during collection of samples. Samples shall be collected by pushing the sampler. Driving by hammer above ground level (like SPT) is not acceptable. However, for stiff / hard soil a sliding hammer can be used for driving the sampler at sampler head

5.4 DISTURBED SAMPLES

Disturbed soil/wash samples shall be collected at every 0.5m intervals and at every change of strata from boreholes. Identification labels indicating depth, borehole no. and visual soil classification shall be affixed on the containers

5.5 TRIAL PITS

The depth of pit shall be 3.0m or up to level of ROCK encountered whichever is less. The size of pit shall be 2.5mX2.5m at top and to be gradually reduced to 1.5mx1.5m at a depth 2.0m from ground level. Size of pit below 2.0m depth shall be 1.5mX1.5m up to the end of the pit. The pit shall be kept open for visual observation of the representative of CLIENT/EIL. Logging of pit shall be made, bulk undisturbed /disturbed sample shall be collected for lab test. Necessary arrangement for pumping /ladder shall be made during inspection of pit.

5.6 ELECTRICAL RESISTIVITY TEST

This test shall be conducted in the Field at specified Locations as per IS :3043 (latest edition)

6.0 LABORATORY TESTS

- 6.1 After collecting disturbed and undisturbed samples from different boreholes at different depths a laboratory test schedule shall be prepared and submitted to OWNER/EIL for review. Adequate number of the following tests shall be conducted to clearly determine the mechanical strength and compressibility characteristics of each strata of soil encountered. All tests on rock and soil samples shall confirm to IS codes of practice. The laboratory tests shall essentially comprise of but not limited to the followings:

6.2 Grain Size Distribution

Wherever applicable both the sieve & hydrometer analysis shall be conducted to indicate complete range of grain sizes of soil samples tested.

6.3 Atterberg Limits

Wherever applicable, these tests shall be carried out by the skilled personnel. The test result should include liquid limit, plastic limit and shrinkage limit of the soil samples tested. These tests should be conducted as per IS-2720, Part V & VI.

6.4 Consolidation Tests

The following loading stages shall be employed:

0.10, .25, 0.50, 1.0, 2.0, 4.0, 8.0 kg/cm².

From e Vs log p curves; pre consolidation pressure shall be determined to establish whether the soil is normally consolidated or over-consolidated. The point (e, p) showing initial condition of the soil under test must be specifically marked on the consolidation curves. Settlement predictions based on the field virgin compression curve shall only be acceptable. The procedure adopted in respect of obtaining compression indices from the field curve & that for computing settlements for the type of clay under consideration shall be clearly illustrated in the report.

It is to be noted that deviations from the standard procedure of performing consolidation tests given in IS-2720 Part XV are permissible in order to enable computation of settlements based on the above procedure i.e cycle(s) of loading, unloading & reloading shall be employed wherever required.

The following curves shall be included in the report:

- a) e Vs log P
- b) e Vs p
- c) Compression Vs log (t) or compression Vs t

The choice of relationship depends upon the shape of the plot which enables, clear determination of C_v , the coefficient of consolidation.

The time period required for 50% & 90% primary consolidation shall be given in the report. Computation of secondary settlements, if significant, shall also be made and included in the report.

6.5 Unconfined Compressive Strength

These tests shall be done as per IS-2720 (Part- X) on selected soil sample

6.6 Triaxial Tests

These tests shall be done on specimens saturated by the applicable of back pressure. Only if the water table is at sufficient depth so 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. The magnitude of the back pressure applied shall be indicated in the report.

All the stress strain diagrams as well as Mohr circle envelopes shall be included in the report. Density and water content of the sample tested and modulus of elasticity along with shear strength parameters shall be reported.

6.7 Modulus of Elasticity

E-value shall be determined from the tri axial tests. Relative corrections applied to the computed 'E' shall be clearly illustrated in the report.

6.8 Chemical Tests

Chemical tests shall be conducted on soil and water samples as per relevant BIS (latest revision) to report the following:

- a) pH
- b) Chlorides in ppm & percentage
- c) Sulphates in ppm, percentage & expressed as SO_3 & SO_4

6.9 Free Swell Index & Swelling Pressure Test

Wherever applicable, these tests shall be conducted on the selected soil samples collected from boreholes/trial pits from different depths, as per relevant IS codes (latest edition).

6.10 Tests on Rock Samples

The crushing strength and point load strength of Rock samples shall be determined by carrying out tests on the selected rock samples as per relevant IS codes (latest edition)

6.11 CBR Test

Laboratory CBR tests shall be carried out under both soaked and unsoaked conditions on soil samples (to be collected by the contractor from borrow pit area or as per instruction of Engineer-in-charge) compacted to OMC (Optimum moisture Content). This test shall be carried out as per IS 2720 Part XIV. The Soil samples for the test shall be compacted to the maximum density at optimum moisture content determined in accordance with 2720 Part VIII.

7.0 REPORT

7.1 Interim reports shall be furnished at various stages of investigation for our comments.

7.2 Detailed report(s) shall be prepared and submitted to OWNER/EIL as soon as the field and laboratory works are completed in a draft form for review and comments. All the information as mentioned below shall be furnished in the draft copy of final report. After reviewing, contractor shall be informed about our comments/remarks, if any, the same shall be incorporated in the final report. The report shall include but not limited to following:

1. A plot plan showing all the test locations with respect to reference chainage.
2. General geological information of the site.
3. Character and genesis of soil.
4. Procedure of investigation and method of various testing adopted.
5. Detailed bore logs indicating co-ordinates, reduced level, ground water table etc., subsoil section along various profiles indicating boreholes nos. depth wise in situ tests like SPT.
6. All field and laboratory test results shall be plotted against depth and also in tabular form.
7. Summary of results obtained from various tests and their interpretation to evaluate various soil parameters.
8. Ultimate and safe bearing capacity from shear as well as from settlement criteria (i.e. for 25mm & 40mm) for the shallow footings of size ranging from 1m to 4m and for rafts of size greater 6.0m placed at different depths from 1 to 3 meters. The recommendation shall also contain provision of basement raft and its construction aspects. The recommended bearing capacities shall be worked out based on various field and laboratory tests.
9. Recommendations of CBR value etc regarding design and construction of roads and other paved structures and also suitability of soil for back filling in foundations.
10. Hydrological data such as maximum velocity, discharge, HFL for each river crossing site based on the data collected. The details of the basis of the data presented shall also be furnished i.e details of the data from authentic source etc.
11. The historical local data available for any bank erosion, scour observed at near bridge etc. for each river crossings, change in the river course including the source of the data

7.3 All recommendations shall be supported by back up calculations.

8.0 LIST OF ATTACHMENT

- 1) Drawing No. – A027-010-16-71-3001 (Rev. 0)